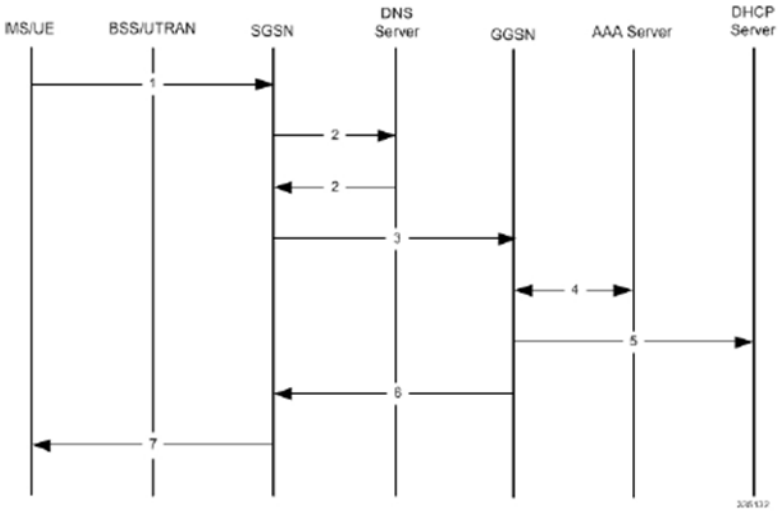
EXHIBIT 9

EXHIBIT B

U.S. Patent No. 7,443,859 v. Cisco's Mobile Multimedia Gateway Platform

U.S. Patent No. 7,443,859	Application to Cisco's Mobile Multimedia Gateway Platform
CLAIM 1	
1[Pre.] A method comprising:	To any extent the preamble is limiting, Cisco's Mobile Multimedia Gateway Platform, including, but not limited to, Cisco ASR 5500, Cisco ASR 5700, and Cisco Virtual Packet Core, practices a method comprising the elements set forth below. StarOS provides a highly flexible and efficient Serving GPRS Support Node (SGSN) service to Cisco's Mobile Multimedia Gateway Platform. For example, "StarOS provides a highly flexible and efficient Serving GPRS Support Node (SGSN) service to the wireless carriers. Functioning as an SGSN, the system readily handles wireless data services within 2.5G General Packet RadioService (GPRS) and 3G Universal Mobile Telecommunications System (UMTS) data networks. The SGSN also can serve as an interface between GPRS and/or UMTS networks and the 4G Evolved Packet Core (EPC) network." *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 5 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 26; CISCO-WSOU-00007552 at 24; CISCO-WSOU-00007592 at 22; CISCO-WSOU-00007605 at 20.
1[A] receiving an Activate Packet Data Protocol (PDP) Context Request message at a Serving General Packet Radio System (GPRS) Support Node (SGSN) of a	Cisco's Mobile Multimedia Gateway Platform practices a method of receiving an Activate Packet Data Protocol (PDP) Context Request message at a Serving General Packet Radio System (GPRS) Support Node (SGSN) of a network from a mobile station of the network, the Activate PDP Context Request message having an APN (Access Point Name) field containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to the mobile station. For example, as shown below in Step 1, the SGSN receives a PDP Activation Request message from a mobile station (MS, or UE "User Equipment") containing an APN field.

network from a mobile station of the network, the Activate PDP Context Request message having an APN (Access Point Name) field containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to the mobile station; and	**PDP Context Activation Procedures** The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. ***Figure 9: Call Flow for PDP Context Activation***  The following table provides detailed explanations for each step indicated in the figure above. ***Table 3: PDP Context Activation Procedure*** **Step** | **Description** 1 | The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN). *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89. The APN indicates requesting either a private network address or a public network address. The GGSN/P-GW has an APN restriction value for each APN that explicitly indicate the request for a private or public network address to be

assigned to the mobile station. For example, when the "APN Restriction Value allowed to be established" is "1" then the "Private" APN for Corporate is assigned in the exemplary manner shown below.

Table 13: APN restriction values

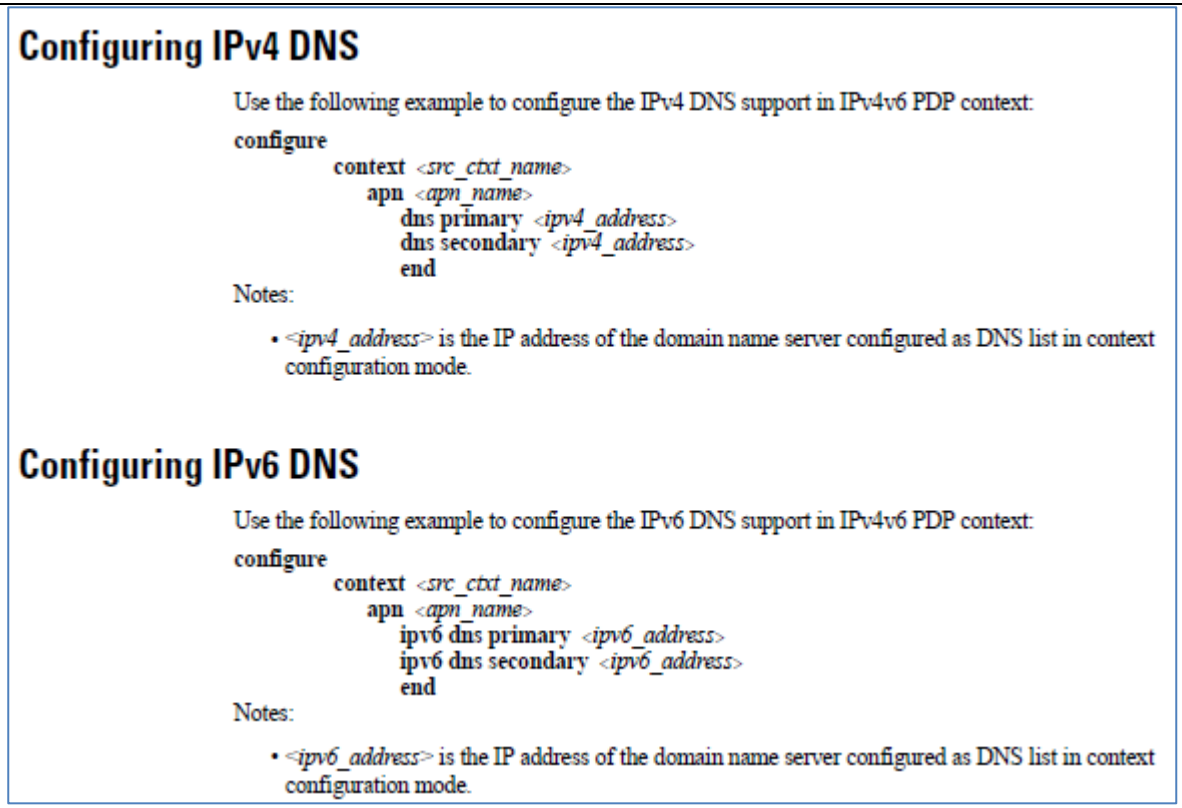
Maximum APN Restriction Value	Type of APN	Application Example	APN Restriction Value allowed to be established
0	No Existing Contexts or Restriction		All
1	Public-1	WAP or MMS	1, 2, 3
2	Public-2	Internet or PSPDN	1, 2
3	Private-1	Corporate (for example MMS subscribers)	1
4	Private-2	Corporate (for example non-MMS subscribers)	None

See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf at 184]; CISCO-WSOU-00007509 at 203; CISCO-WSOU-00007552 at 201.

"During default bearer activation, the SGSN sends the current Maximum APN restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send." This indicates that each APN corresponds to either a public, or a private address, according to its associated APN restriction value. For example, the "APN Restriction value corresponding to each APN is known by the GGSN/P-GW. The Gn/S4-SGSN sends the Maximum APN Restriction of the UE ["User Equipment"] to the GGSN/P-GW in a Create PDP Context Request/Create Session Request. The GGSN/P-GW accepts or rejects the activation based on the Maximum APN Restriction of UE and APN Restriction value of that APN which is sent the Create PDP Context Request/Create Session Request... This feature provides the operator with increased control to restrict certain APNs to UEs based on the type of APN." WSOU-CISCO013800 at 183-184; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.

2	The SGSN sends a DNS query to resolve the APN provided by the MS/UE to a GGSN address. The DNS server provides a response containing the IP address of a GGSN.

See, e.g., WSOU-CISCO013800 at 80; CISCO-WSOU-00007509 at 100; CISCO-WSOU-00007552 at 99; CISCO-WSOU-00007592 at 95; CISCO-WSOU-00007605 at 89; CISCO-WSOU-00007745 at 739; CISCO-WSOU-00007746 at 683; CISCO-WSOU-00008626 at 693; CISCO-WSOU-00008627 at 1044; CISCO-WSOU-00008631 at 1022.



Configuring IPv4 DNS

Use the following example to configure the IPv4 DNS support in IPv4v6 PDP context:

```
configure
    context <src_ctxt_name>
        apn <apn_name>
            dns primary <ipv4_address>
            dns secondary <ipv4_address>
            end
```

Notes:

- <*ipv4_address*> is the IP address of the domain name server configured as DNS list in context configuration mode.

Configuring IPv6 DNS

Use the following example to configure the IPv6 DNS support in IPv4v6 PDP context:

```
configure
    context <src_ctxt_name>
        apn <apn_name>
            ipv6 dns primary <ipv6_address>
            ipv6 dns secondary <ipv6_address>
            end
```

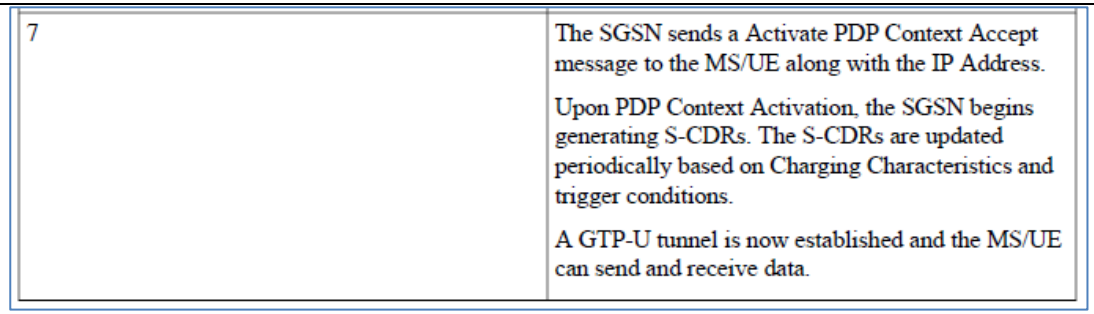
Notes:

- <*ipv6_address*> is the IP address of the domain name server configured as DNS list in context configuration mode.

See WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 104]; CISCO-WSOU-00007483 at 132-133; CISCO-WSOU-00007525 at 130-131; CISCO-WSOU-00007568 at 199-200; CISCO-WSOU-00007611 at 197-198; CISCO-WSOU-00008600 at 197-198; CISCO-WSOU-00008610 at 130-131; CISCO-WSOU-00008744 at 199-200; CISCO-WSOU-00008745 at 101-102; CISCO-WSOU-00008747 at 132-133; CISCO-WSOU-00008883 at 100; CISCO-WSOU-00008899 at 102.

"Before an MS is able to access data services, they must have an IP address. As described previously, the GGSN supports static or dynamic addressing (through locally configured address pools on the system, DHCP client-mode, or DHCP relay-mode). Regardless of the allocation method, a corresponding address pool must be configured." *See*

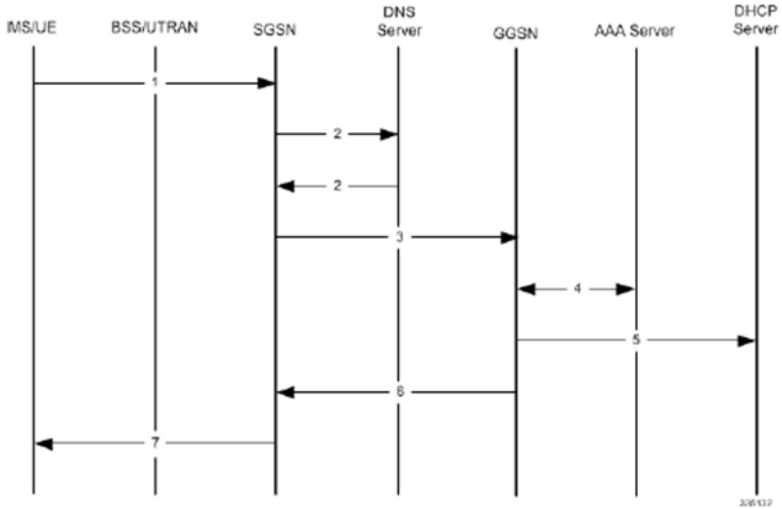
	WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-a 3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 104 (April 27, 2017)]; *see also, e.g.*, CISCO-WSOU-00007483 at 134; CISCO-WSOU-00008899 at 102-103; CISCO-WSOU-00008745 at 102-103. **Step 1** Create the IP pool for IPv4 addresses in system context by applying the example configuration in the *IPv4 Pool Creation* section. **Step 2** Optional. Configure the IP pool for IPv6 addresses in system context by applying the example configuration in the *IPv6 Pool Creation* section. **Step 3** Verify your IP pool configuration by following the steps in the *IP Pool Configuration Verification* section. **Step 4** Save your configuration as described in the *Verifying and Saving Your Configuration* chapter. WSOU-CISCO012990 at 105; CISCO-WSOU-00007483 at 134-135; CISCO-WSOU-00008899 at 103-104; CISCO-WSOU-00008745 at 103-104. **IPv4 Pool Creation** Use the following example to create the IPv4 address pool: **configure** **context** *<dest_ctxt_name>* **ip pool** *<pool_name> <ip_address/mask>* **[{private| public}[priority]] | static]** **end** WSOU-CISCO012990 at 106; CISCO-WSOU-00007483 at 135; CISCO-WSOU-00008899 at 104; CISCO-WSOU-00008745 at 102-104.
1[B] sending an Activate PDP Context Accept message to the mobile station containing information assigning one of a	Cisco's Mobile Multimedia Gateway Platform practices a method of sending an Activate PDP Context Accept message to the mobile station containing information assigning one of a private network address and a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message. For example, as shown below in Step 7, the SGSN sends the Activate PDP Context Accept message to the mobile station (MS) along with the IP Address.

private network address and a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message.	 7 — The SGSN sends a Activate PDP Context Accept message to the MS/UE along with the IP Address. Upon PDP Context Activation, the SGSN begins generating S-CDRs. The S-CDRs are updated periodically based on Charging Characteristics and trigger conditions. A GTP-U tunnel is now established and the MS/UE can send and receive data. *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 100-101; CISCO-WSOU-00007552 at 99-100; CISCO-WSOU-00007592 at 95-96; CISCO-WSOU-00007605 at 89-90; CISCO-WSOU-00007745 at 739-740; CISCO-WSOU-00007746 at 683-684; CISCO-WSOU-00008626 at 693-694; CISCO-WSOU-00008627 at 1044-1045; CISCO-WSOU-00008631 at 1022-1023.

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

2	The SGSN sends a DNS query to resolve the APN provided by the MS/UE to a GGSN address. The DNS server provides a response containing the IP address of a GGSN.

3	The SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context.
4	If required, the GGSN performs authentication of the subscriber.

5	If the MS/UE requires an IP address, the GGSN may allocate one dynamically via DHCP.
6	The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.

See, e.g., WSOU-CISCO013800 at 81; CISCO-WSOU-00007509 at 100-101; CISCO-WSOU-00007552 at 99-100; CISCO-WSOU-00007592 at 95-96; CISCO-WSOU-00007605 at 89-90; CISCO-WSOU-00007745 at 739-740; CISCO-WSOU-00007746 at 683-684; CISCO-WSOU-00008626 at 693-694; CISCO-WSOU-00008627 at 1044-1045; CISCO-WSOU-00008631 at 1022-1023.

The GGSN has an APN Restriction value for each APN request by UE/MS. The GGSN checks whether the APN Restriction value received in the Create PDP Context Request from the SGSN and the APN Restriction value of the APN to which access is requested are the same. If the values are the same, the GGSN creates the PDP context and sends a create response message back to the SGSN containing the IP address assigned to the UE/MS in Step 6. The SGSN then sends an Activate PDP Context Accept message to the UE/MS in Step 7 along with the public or private IP address from GGSN. WSOU-CISCO013800 at 80-81, 84.

CLAIM 2

2[A] The method according to claim 1, further comprising: sending	Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 1, *see supra* 1[Pre.]-1[B], further comprising sending a Create PDP Context Request message from the SGSN to a Gateway General Packet Radio System (GPRS) Support Node (GGSN) of the network, the Create PDP Context Request message having an

<table>
<tr>
<td>a Create PDP Context Request message from the SGSN to a Gateway General Packet Radio System (GPRS) Support Node (GGSN) of the network, the Create PDP Context Request message having an APN field containing information relating to a request for either a private network address or a public network address for the mobile station; and</td>
<td>APN field containing information relating to a request for either a private network address or a public network address for the mobile station.

For example, as shown in Step 3 below, to resolve the received APN in the PDP activation request message, the SGSN sends a Create PDP Context Request to the GGSN, which works in conjunction with the SGSN to identify the APN the mobile station is attempting to connect to and other information about the subscriber. The SGSN sends an APN Restriction value (Maximum APN Restriction) in the Create PDP Context Request for establishing a PDP context.

<table>
<tr><td>3</td><td>The SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context.</td></tr>
</table>

See WSOU-CISCO013800 [SGSN Administration Guide, StarOS Release 21.15, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)].

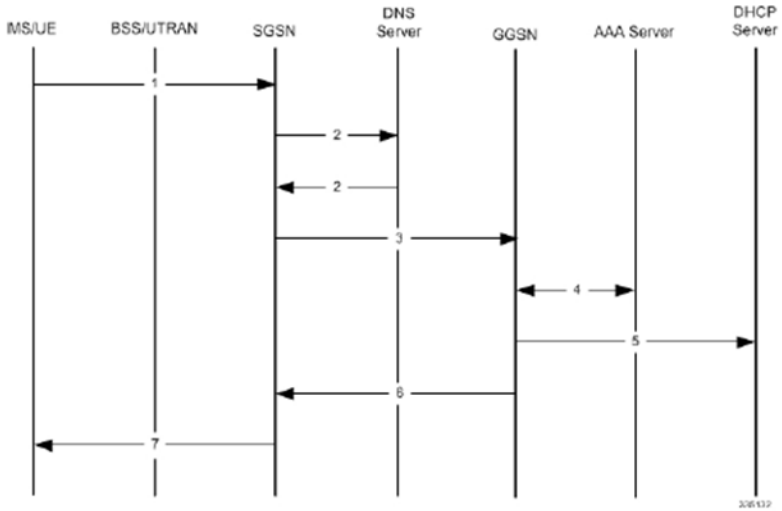
SGSN and Dual Access SGSN Deployments
SGSNs and GGSNs work in conjunction within the GPRS/UMTS network. As indicated earlier in the section on System Configuration Options, the flexible architecture of StarOS enables a single chassis to reduce hardware requirements by supporting integrated co-location of a variety of the SGSN services.

Id. at 5.</td>
</tr>
</table>

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

See, e.g., *id.* at 80; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

The SGSN sends the Create PDP Context Request message that contains an APN field. . For example, in the PDP Activation procedure, "[t]he SGSN sends a Create PDP Context Request message to the GGSN. This message identifies the APN the UE is attempting to connect to and other information about the subscriber." WSOU-CISCO013800 at 102.

	1. A PDP Activation Request message is sent from the UE to the SGSN by the BSS over the Gb interface. This request includes the Access Point Name (APN) the UE is attempting to connect to. This is typically a Frame relay connection. 2. The SGSN queries the DNS server to resolve the APN to the IP address of the GGSN to use to establish the PDP context. 3. The SGSN sends a Create PDP Context Request message to the GGSN. This message identifies the APN the UE is attempting to connect to and other information about the subscriber. 4. The GGSN performs its processes for establishing the PDP context. This may include subscriber authentication, service provisioning, etc. The GGSN eventually sends an affirmative create PDP context response to the SGSN containing the IP address assigned to the UE. 5. The SGSN sends an Activate PDP Context Accept message back to the UE. The subscriber can now begin sending/receiving data. 6. The SGSN begins generating S-CDR data that will be sent to the CG. *See, e.g., id.* Further, the APN field in the Create PDP Context Request contains information relating to a request for either a private network address or a public network address for the mobile station. The APN field indicates requesting either a private network address of a public network address. The GGSN/P-GW has an APN restriction value corresponding to each APN, and indicating that an APN is either a public, or a private address, according to its associated APN restriction value. For example, see claim 1 and below. The APN indicates requesting either a private network address or a public network address. The GGSN/P-GW has an APN restriction value for each APN that explicitly indicate the request for a private or public network address to be assigned to the mobile station. For example, when the “APN Restriction Value allowed to be established” is “1” then the “Private” APN for Corporate is assigned in the exemplary manner shown below.

Table 13: APN restriction values

Maximum APN Restriction Value	Type of APN	Application Example	APN Restriction Value allowed to be established
0	No Existing Contexts or Restriction		All
1	Public-1	WAP or MMS	1, 2, 3
2	Public-2	Internet or PSPDN	1, 2
3	Private-1	Corporate (for example MMS subscribers)	1
4	Private-2	Corporate (for example non-MMS subscribers)	None

See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf at 184]; CISCO-WSOU-00007509 at 203; CISCO-WSOU-00007552 at 201.

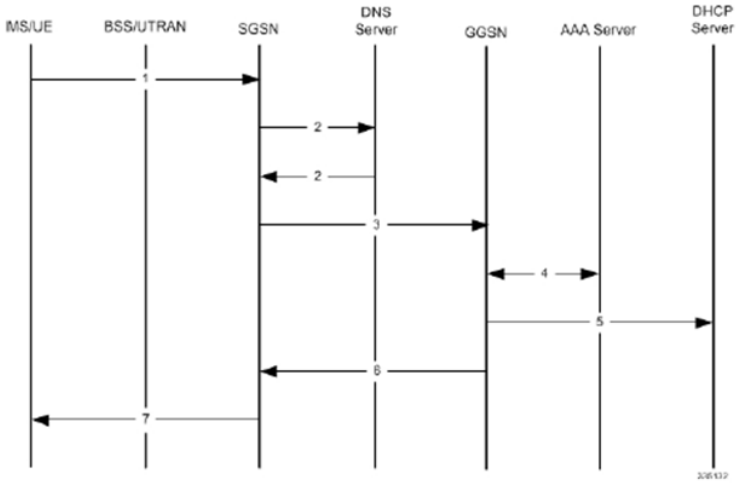
"During default bearer activation, the SGSN sends the current Maximum APN restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send." This indicates that each APN corresponds to either a public, or a private address, according to its associated APN restriction value. For example, the "APN Restriction value corresponding to each APN is known by the GGSN/P-GW. The Gn/S4-SGSN sends the Maximum APN Restriction of the UE ["User Equipment"] to the GGSN/P-GW in a Create PDP Context Request/Create Session Request. The GGSN/P-GW accepts or rejects the activation based on the Maximum APN Restriction of UE and APN Restriction value of that APN which is sent the Create PDP Context Request/Create Session Request... This feature provides the operator with increased control to restrict certain APNs to UEs based on the type of APN." WSOU-CISCO013800 at 183-184; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.

	<table><tr><td>2</td><td>The SGSN sends a DNS query to resolve the APN provided by the MS/UE to a GGSN address. The DNS server provides a response containing the IP address of a GGSN.</td></tr></table> *See, e.g.*, WSOU-CISCO013800 at 80; CISCO-WSOU-00007509 at 100; CISCO-WSOU-00007552 at 99; CISCO-WSOU-00007592 at 95; CISCO-WSOU-00007605 at 89; CISCO-WSOU-00007745 at 739; CISCO-WSOU-00007746 at 683; CISCO-WSOU-00008626 at 693; CISCO-WSOU-00008627 at 1044; CISCO-WSOU-00008631 at 1022.
2[B] receiving a Create PDP Context Response message from the GGSN containing information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message.	Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 1, *see supra* 1[Pre.]-1[B], further comprising receiving a Create PDP Context Response message from the GGSN containing information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message. For example, as shown below in Step 6, once an IP address (public or private depending on the APN request) is chosen, the GGSN sends a Create PDP Context Response message to the SGSN containing the IP address assigned to the mobile station. <table><tr><td>6</td><td>The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.</td></tr></table> *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

The IP address is resolved by the DNS server and checked by the GGSN, both according to information contained in the APN field of the Activate PDP Context Request message sent from the MS/UE (Mobile Station) to SGSN. The IP address can be either a private network address or a public network address. The GGSN/P-GW has an APN restriction

<table>
<tr><td></td><td>value for each APN, and each APN corresponds to either a public, or a private address, according to its associated APN restriction value. For example, see claim 1.</td></tr>
<tr><td colspan="2">CLAIM 3</td></tr>
<tr><td>3[A] The method according to claim 2, further comprising: receiving the Create PDP Context Request message from the SGSN at the GGSN;</td><td>Cisco’s Mobile Multimedia Gateway Platform practices the method according to claim 2, see supra 2[A]-2[B], and further comprises receiving the Create PDP Context Request message from the SGSN at the GGSN.

For example, as shown in Step 3 below, the SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context.

<table><tr><td>3</td><td>The SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context.</td></tr></table>

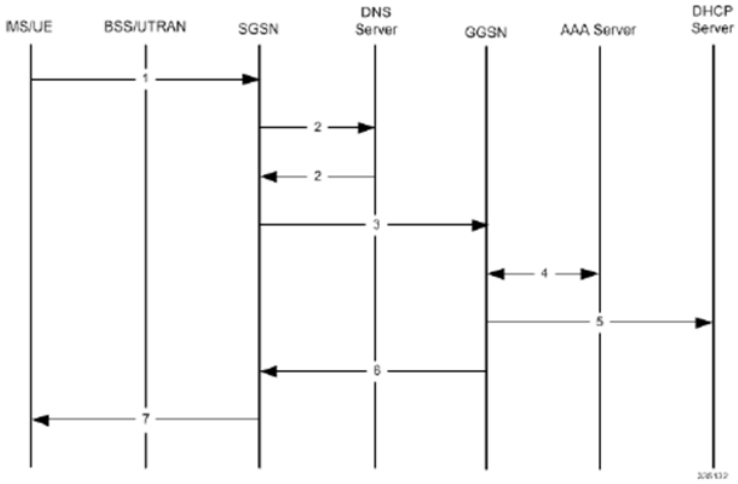
See, e.g., WSOU-CISCO013800 [SGSN Administration Guide, StarOS Release 21.15, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].</td></tr>
</table>

<table>
<tr><td></td><td>

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

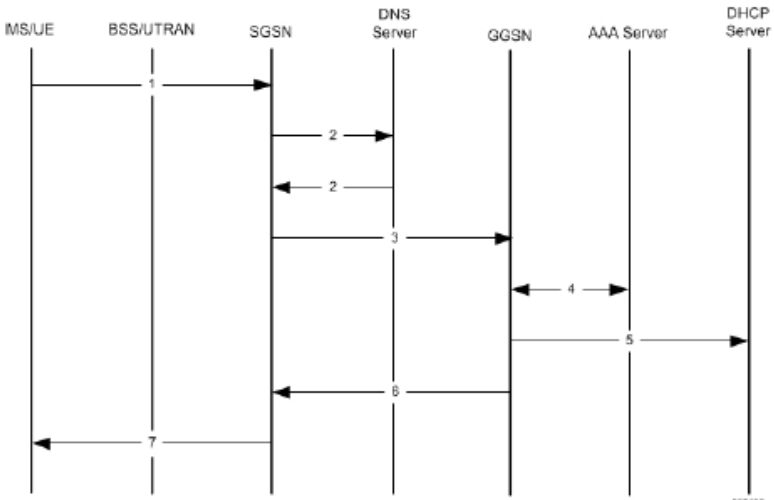
See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

</td></tr>
<tr><td>**3[B]** assigning either a private network address or a public network address to</td><td>Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 2, *see supra* 2[B], and further comprises assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message.</td></tr>
</table>

the mobile station based on the information contained in the APN field of the Create PDP Context Request message and	The Create PDP Context Request contains an APN field containing information relating to a request for either a private network address or a public network address for the mobile station. For example, see 2[A]. As shown below, the mobile station is assigned an IP address (public or private) based on the information contained in the APN field of the Create PDP Context Request message. The GGSN checks whether the APN Restriction value received in the Create PDP Context Request from the SGSN and the APN Restriction value of the APN to which access is requested are the same. For example, "[d]uring default bearer activation the Gn/S4-SGSN sends the current Maximum APN Restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (if it is the first activation for that UE or if the APN Restriction is disabled, Maximum APN restriction will be "0" in the Create PDP Context Request/Create Session Request). The GGSN/P-GW has an APN restriction value for each APN. If the Maximum APN Restriction for the subscriber is received in the Create PDP Context Request/Create Session Request and APN Restriction value of the APN to which activation is being requested do not concur then the GGSN/P-GW rejects the activation by sending a Create PDP Context/Create Session Response failure message to the G/S4-SGSN with EGTP cause EGTP_CAUSE_INCOMPATIBLE_APN_REST_TYPE (0x68)." *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 184 (Aug. 29, 2019)]. If the values are the same, the GGSN creates the PDP context and sends a create response message back to the SGSN containing the IP address assigned to the UE/MS in Step 6. The SGSN then sends an Activate PDP Context Accept message to the UE/MS in Step 7 along with the public or private IP address from GGSN.

Step	Description
5	If the MS/UE requires an IP address, the GGSN may allocate one dynamically via DHCP.
6	The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.
7	The SGSN sends a Activate PDP Context Accept message to the MS/UE along with the IP Address. Upon PDP Context Activation, the SGSN begins generating S-CDRs. The S-CDRs are updated periodically based on Charging Characteristics and trigger conditions. A GTP-U tunnel is now established and the MS/UE can send and receive data.

See WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].

	PDP Context Activation Procedures The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. ***Figure 9: Call Flow for PDP Context Activation***  *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.
3[C] sending the Create PDP Context Response message from the GGSN to the SGSN containing the information assigning either a	Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 2, *see supra* 2[A]-2[B], and further comprises sending the Create PDP Context Response message from the GGSN to the SGSN containing the information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message. For example, as shown below in Step 6, the GGSN sends a Create PDP Context Response message to the SGSN containing the IP address (public or private depending on the APN request) assigned to the mobile station.

private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message.	

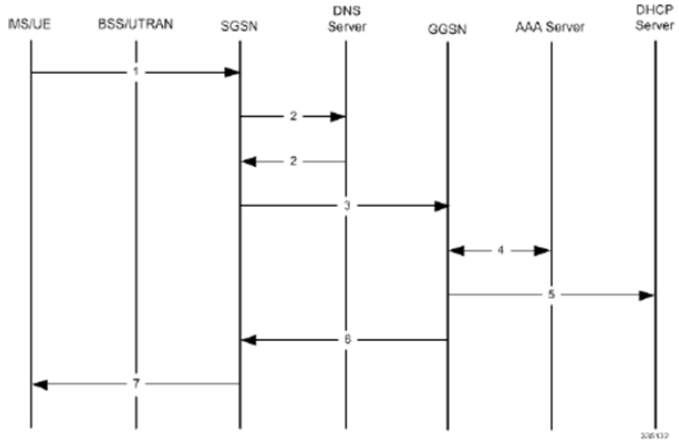
6	The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.

See WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

See, e.g., id. at 80; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

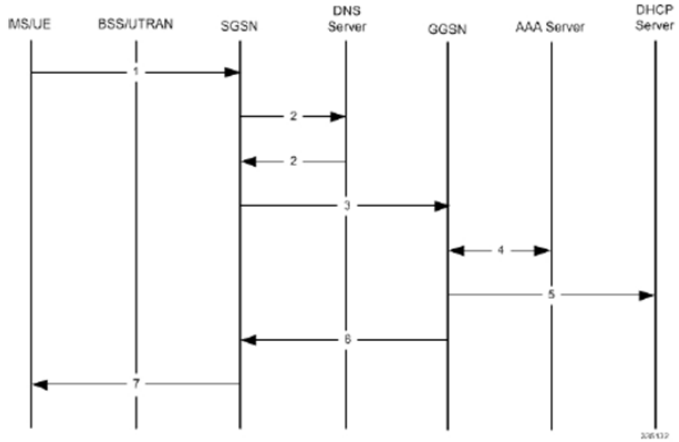
As discussed above, the IP address sent in the Create PDP Context Response message from the GGSN to the SGSN is based on the information contained in the APN field of the Create PDP Context Request message. The IP address can be either a public address or a private address. For example, see also 2[A] and 3[B].

CLAIM 4	
4[A] The method according to claim 1, further comprising: sending a Create PDP Context Request message from the SGSN to a Border Gateway (BG) of the network, the Create PDP Context Request message having an APN field containing information relating to a request for either a private network address or a public network address for the mobile station; and	Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 1, *see supra* 1[Pre.]-1[B], and further comprises sending a Create PDP Context Request message from the SGSN to a Border Gateway (BG) of the network, the Create PDP Context Request message having an APN field containing information relating to a request for either a private network address or a public network address for the mobile station, *see supra* 2[A]-2[B]. For example, StarOS includes both "Standalone gateway GPRS support node (GGSN)" and "Co-located P-GW/GGSN" deployments and interfaces. On information and belief, the SGSN sends a Create PDP Context Request message to a Gateway General Packet Radio System (GPRS) Support Node (GGSN) or to a Border Gateway (Packet Gateway: P-GW). *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 6-7 (Aug. 29, 2019)]. For example, "[d]uring default bearer activation, the SGSN sends the current maximum APN restriction value for the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send. If the maximum APN restriction of the UE (received in the CSR) and the APN Restriction value of the APN (for which activation is being requested) do not concur, then the GGSN/P-GW rejects activation. The maximum APN restriction for a UE is the most restrictive based on all already active default EPS bearers. The purpose of enabling APN Restriction in S4-SGSN is to determine whether the UE is allowed to establish EPS Bearers with other APNs based on the Maximum APN Restriction value associated with that UE." *Id.* at 23, 183-84; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



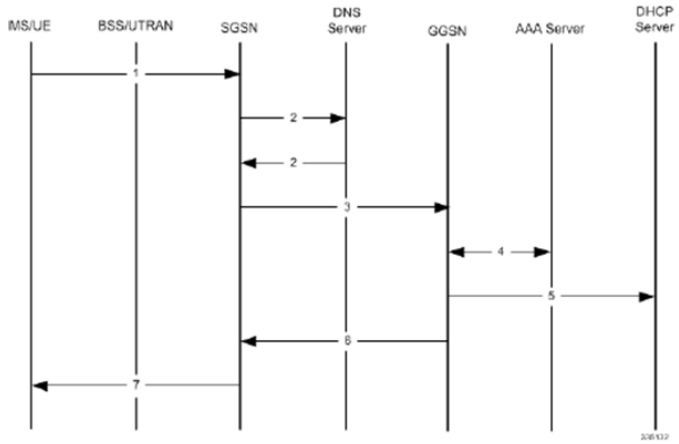
The following table provides detailed explanations for each step indicated in the figure above.

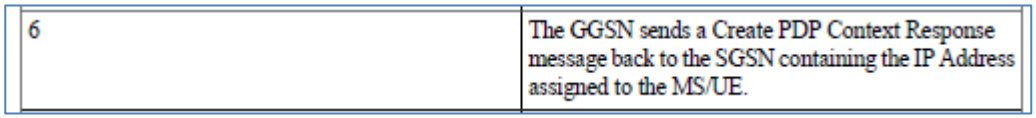
See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

SGSN sends a Create PDP Context Request message to a Gateway General Packet Radio System (GPRS) Support Node (GGSN) of the network, the Create PDP Context Request message having an APN field containing information relating to a request for either a private network address or a public network address for the mobile station. For example, see 2[A].

Given that the co-located GGSN/P-GW utilizes the same PDP Context Activation Procedures, in a workflow with co-located GGSN/P-GW, SGSN sends a Create PDP Context Request message to the P-GW, the Create PDP Context Request message having an APN field containing information relating to a request for either a private network address or a public network address for the mobile station.

	As shown in Step 3 below, to resolve the received APN in the PDP activation request message, the SGSN sends a Create PDP Context Request to the GGSN. In the same PDP Context Activation Procedures involving a co-located GGSN/P-GW, the SGSN sends a Create PDP Context Request to the P-GW, which works in conjunction with the SGSN to identify the APN the mobile station is attempting to connect to and other information about the subscriber. The SGSN sends an APN Restriction value (Maximum APN Restriction) in the Create PDP Context Request for establishing a PDP context. 3 — The SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context. *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)].
4[B] receiving a Create PDP Context Response message at the SGSN from the BG containing information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP	Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 1, *see supra* 1[Pre.]-1[B], and further comprises receiving a Create PDP Context Response message at the SGSN from the BG containing information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message. For example, StarOS includes both "Standalone gateway GPRS support node (GGSN)" and "Co-located P-GW/GGSN" deployments and interfaces. On information and belief, the SGSN receives a Create PDP Context Response message from a Gateway General Packet Radio System (GPRS) Support Node (GGSN) or a Border Gateway (Packet Gateway: P-GW). *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 6-7 (Aug. 29, 2019)]. For example, "[d]uring default bearer activation, the SGSN sends the current maximum APN restriction value for the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send. If the maximum APN restriction of the UE (received in the CSR) and the APN Restriction value of the APN (for which activation is being requested) do not concur, then the GGSN/P-GW rejects

Context Request message.	activation. The maximum APN restriction for a UE is the most restrictive based on all already active default EPS bearers. The purpose of enabling APN Restriction in S4-SGSN is to determine whether the UE is allowed to establish EPS Bearers with other APNs based on the Maximum APN Restriction value associated with that UE." *Id.* at 23, 183-184; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379. Therefore, the following figure and table specifying the PDP Context Activation Procedures workflow, that involves sending a Create PDP Context Request message, applies for both the Gateway General Packet Radio System (GPRS) Support Node (GGSN) or to a co-located GGSN/P-GW, as well as the same APN Restriction feature. **PDP Context Activation Procedures** The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. ***Figure 9: Call Flow for PDP Context Activation***  The following table provides detailed explanations for each step indicated in the figure above. *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

	SGSN receives a Create PDP Context Response message from the GGSN containing information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message. For example, see 2[B]. Given that the co-located GGSN/P-GW utilizes the same PDP Context Activation Procedures, in a workflow with co-located GGSN/P-GW, SGSN receives a Create PDP Context Response message from P-GW containing information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message. As shown in Step 6 below, once an IP address (public or private depending on the APN request) is chosen, the GGSN sends a Create PDP Context Response message to the SGSN containing the IP address assigned to the mobile station. In the same PDP Context Activation Procedures involving a co-located GGSN/P-GW, P-GW sends a Create PDP Context Response message to the SGSN containing the IP address assigned to the mobile station.  6 — The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE. *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].
CLAIM 5	
5[A] The method according to claim 4, further comprising: receiving the Create PDP Context Request message at the BG;	Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 4, *see supra* 4[A]-4[B], and further comprises, on information and belief, receiving the Create PDP Context Request message at the BG. For example, StarOS includes both "Standalone gateway GPRS support node (GGSN)" and "Co-located P-GW/GGSN" deployments and interfaces. On information and belief, the Border Gateway (Packet Gateway: PW) receives the Create PDP Context Request message. *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 6-7 (Aug. 29, 2019)].

For example, "[d]uring default bearer activation, the SGSN sends the current maximum APN restriction value for the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send. If the maximum APN restriction of the UE (received in the CSR) and the APN Restriction value of the APN (for which activation is being requested) do not concur, then the GGSN/P-GW rejects activation. The maximum APN restriction for a UE is the most restrictive based on all already active default EPS bearers. The purpose of enabling APN Restriction in S4-SGSN is to determine whether the UE is allowed to establish EPS Bearers with other APNs based on the Maximum APN Restriction value associated with that UE." *Id.* at 23, 183-184; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.

Therefore, the following figure and table specifying the PDP Context Activation Procedures workflow, that involves sending a Create PDP Context Request message, applies for both the Gateway General Packet Radio System (GPRS) Support Node (GGSN) or to a co-located GGSN/P-GW, as well as the same APN Restriction feature.

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

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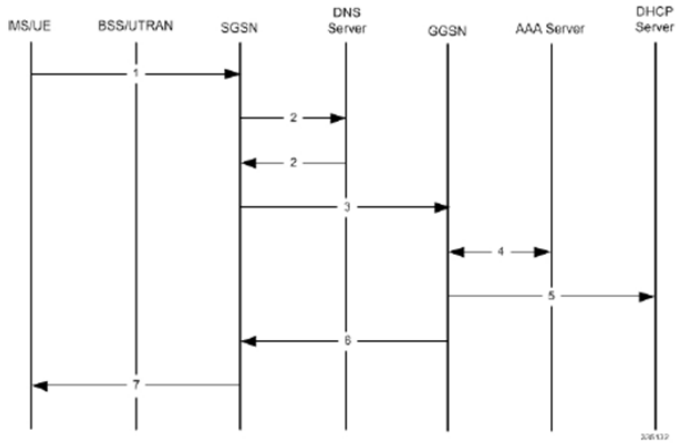

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	See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89. As shown in Step 3 below, the SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context. For example, see 3[A]. Given that the co-located GGSN/P-GW utilizes the same PDP Context Activation Procedures, in a workflow with co-located GGSN/P-GW, the SGSN sends a Create PDP Context Request message to the P-GW containing the information needed to authenticate the subscriber and establish a PDP context. 3 — The SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context. *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)].
5[B] assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message; and	Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 4, *see supra* 4[A]-4[B], and further comprises assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message. For example, "[d]uring default bearer activation, the SGSN sends the current maximum APN restriction value for the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send. If the maximum APN restriction of the UE (received in the CSR) and the APN Restriction value of the APN (for which activation is being requested) do not concur, then the GGSN/P-GW rejects activation. The maximum APN restriction for a UE is the most restrictive based on all already active default EPS bearers. The purpose of enabling APN Restriction in S4-SGSN is to determine whether the UE is allowed to establish EPS Bearers with other APNs based on the Maximum APN Restriction value associated with that UE." *See SGSN*

Administration Guide, StarOS Release 21.15, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 23, 183-84. (Aug. 29, 2019); *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.

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PDP Context Activation Procedures

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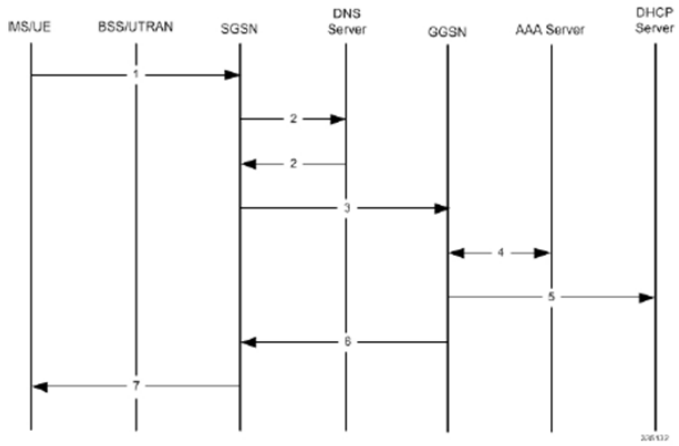

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<table>
<tr>
<td></td>
<td>As shown below, the mobile station is assigned an IP address (public or private) based on the information contained in the APN field of the Create PDP Context Request message. For example, see 3[B].

Given that the co-located GGSN/P-GW utilizes the same PDP Context Activation Procedures, in a workflow with co-located GGSN/P-GW, the mobile station is also assigned an IP address based on the information contained in the APN field of the Create PDP Context Request message. The IP address could be either a public address, or a private address.

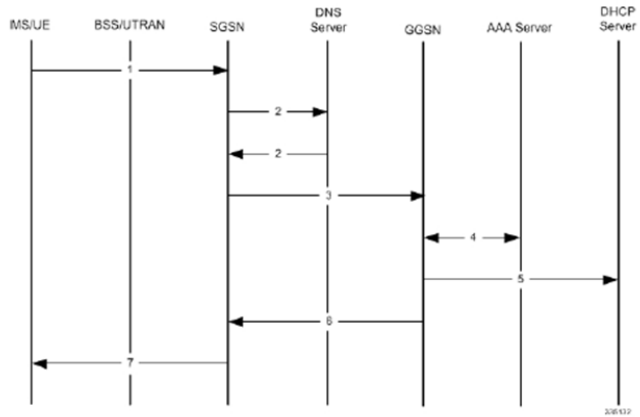
<table>
<tr><th>Step</th><th>Description</th></tr>
<tr><td>5</td><td>If the MS/UE requires an IP address, the GGSN may allocate one dynamically via DHCP.</td></tr>
<tr><td>6</td><td>The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.</td></tr>
<tr><td>7</td><td>The SGSN sends a Activate PDP Context Accept message to the MS/UE along with the IP Address.

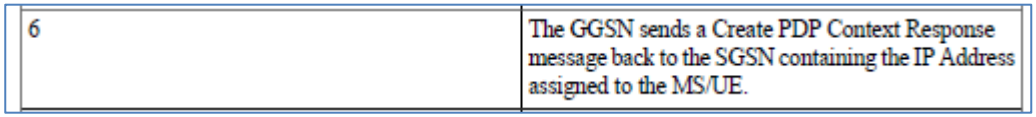
Upon PDP Context Activation, the SGSN begins generating S-CDRs. The S-CDRs are updated periodically based on Charging Characteristics and trigger conditions.

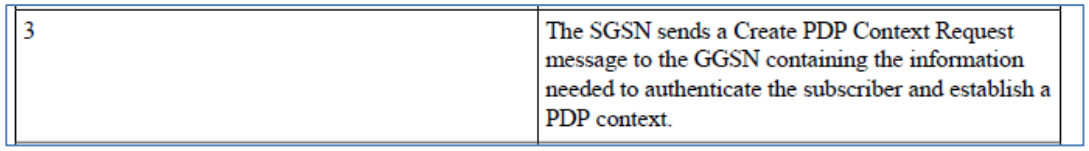
A GTP-U tunnel is now established and the MS/UE can send and receive data.</td></tr>
</table>

WSOU-CISCO013800 at 81.</td>
</tr>
<tr>
<td>5[C] sending the Create PDP Context Response message to the SGSN containing the information assigning either a</td>
<td>Cisco’s Mobile Multimedia Gateway Platform practices the method according to claim 4, see supra 4[A]-4[B], and further comprises sending the Create PDP Context Response message to the SGSN containing the information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message.

For example, “[d]uring default bearer activation, the SGSN sends the current maximum APN restriction value for the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have</td>
</tr>
</table>

private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message.	an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send. If the maximum APN restriction of the UE (received in the CSR) and the APN Restriction value of the APN (for which activation is being requested) do not concur, then the GGSN/P-GW rejects activation. The maximum APN restriction for a UE is the most restrictive based on all already active default EPS bearers. The purpose of enabling APN Restriction in S4-SGSN is to determine whether the UE is allowed to establish EPS Bearers with other APNs based on the Maximum APN Restriction value associated with that UE." *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 23, 183-84 (Aug. 29, 2019)]; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379. Therefore, the following figure and table specifying the PDP Context Activation Procedures workflow, that involves sending a Create PDP Context Request message, applies for both the Gateway General Packet Radio System (GPRS) Support Node (GGSN) or to a co-located GGSN/P-GW, as well as the same APN Restriction feature. **PDP Context Activation Procedures** The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. ***Figure 9: Call Flow for PDP Context Activation***  The following table provides detailed explanations for each step indicated in the figure above.

	See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89. As shown below in Step 6, the SGSN is sent a Create PDP Context Response message containing the IP address (public or private depending on the APN request) assigned to the mobile station. For example, see 3[C]. Given that the co-located GGSN/P-GW utilizes the same PDP Context Activation Procedures, in a workflow with co-located GGSN/P-GW, the SGSN is also sent a Create PDP Context Response message containing the IP address assigned to the mobile station. The IP address could be either a public address, or a private address, depending on the APN request.  6 — The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE. *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].
CLAIM 6	
6[A] The method according to claim 5, further comprising: sending the Create PDP Context Request message from the SGSN to a Gateway General Packet Radio	Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 5, *see supra* 5[A]-5[C], and further comprises sending the Create PDP Context Request message from the SGSN to a Gateway General Packet Radio System (GPRS) Support Node (GGSN) of the network. As shown in Step 3 below, the SGSN sends a Create PDP Context Request message to the GGSN, which works in conjunction with the SGSN to identify the APN the mobile station is attempting to connect to and other information about the subscriber. For example, see rows 3[A] and 5[A]. On information and belief, in PDP Context Activation Procedures with co-located GGSN/P-GW, the SGSN sends a Create PDP Context Request message to the GGSN, which works in conjunction with the SGSN.

System (GPRS) Support Node (GGSN) of the network;	 *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)].

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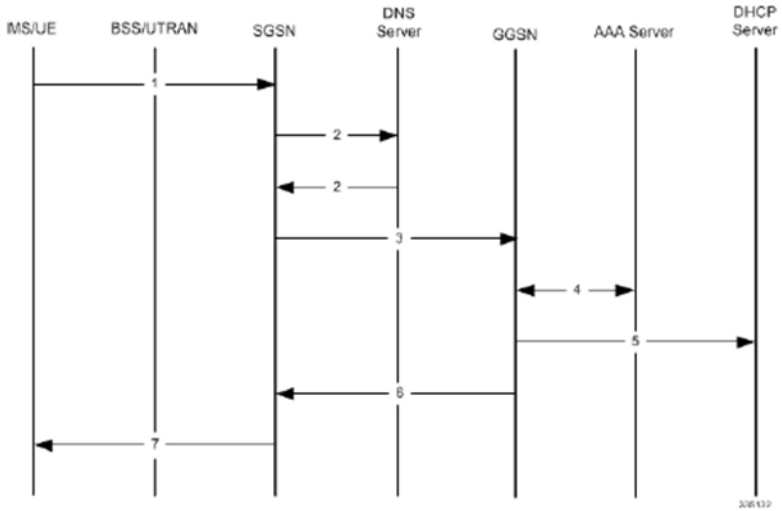
PDP Context Activation Procedures
The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.
Figure 9: Call Flow for PDP Context Activation


The following table provides detailed explanations for each step indicated in the figure above.
Table 3: PDP Context Activation Procedure
<table>
<tr><th>Step</th><th>Description</th></tr>
<tr><td>1</td><td>The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).</td></tr>
</table>

See, e.g., WSOU-CISCO013800 [SGSN Administration Guide, StarOS Release 21.15, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.
</td>
</tr>
<tr>
<td>6[B] sending the Create PDP Context Request message</td>
<td>Cisco’s Mobile Multimedia Gateway Platform practices the method according to claim 5, see supra 5[A]-5[C], and further comprises, on information and belief, sending the Create PDP Context Request message from the GGSN to the Border Gateway (Packet Gateway: P-GW). Cisco’s Mobile Multimedia Gateway Platform includes both</td>
</tr>
</table>

<table>
<tr><td>from the GGSN to the BG;</td><td>“Standalone gateway GPRS support node (GGSN)” and “Co-located P-GW/GGSN” deployments and interfaces. Id. at 6.</td></tr>
<tr><td>6[C] receiving the Create PDP Context Response message at the GGSN from the BG; and</td><td>Cisco’s Mobile Multimedia Gateway Platform practices the method according to claim 5, see supra 5[A]-5[C], and further comprises, on information and belief, receiving the Create PDP Context Response message at the GGSN from the Border Gateway (Packet Gateway: P-GW). Cisco’s Mobile Multimedia Gateway Platform includes both “Standalone gateway GPRS support node (GGSN)” and “Co-located P-GW/GGSN” deployments and interfaces. Id. at 6.</td></tr>
<tr><td>6[D] receiving the Create PDP Context Response message at the SGSN from the GGSN.</td><td>Cisco’s Mobile Multimedia Gateway Platform practices the method according to claim 5, see supra 5[A]-5[C], and further comprises receiving the Create PDP Context Response message at the SGSN from the GGSN.

As shown below in Step 6, the GGSN sends a Create PDP Context Response message to the SGSN containing the IP address assigned to the mobile station. For example, see 3[C] and 5[C].

On information and belief, in PDP Context Activation Procedures with co-located GGSN/P-GW, the SGSN also receives the Create PDP Context Response message from the GGSN.

<table><tr><td>6</td><td>The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.</td></tr></table>

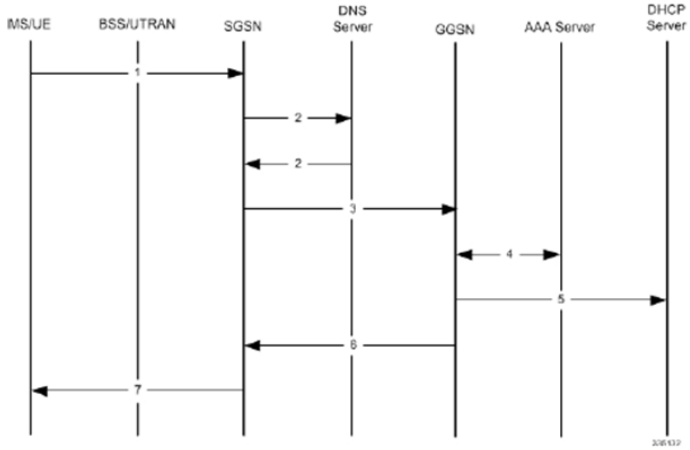
See, e.g., WSOU-CISCO013800 [SGSN Administration Guide, StarOS Release 21.15, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].</td></tr>
</table>

<table>
<tr><td></td><td>

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation

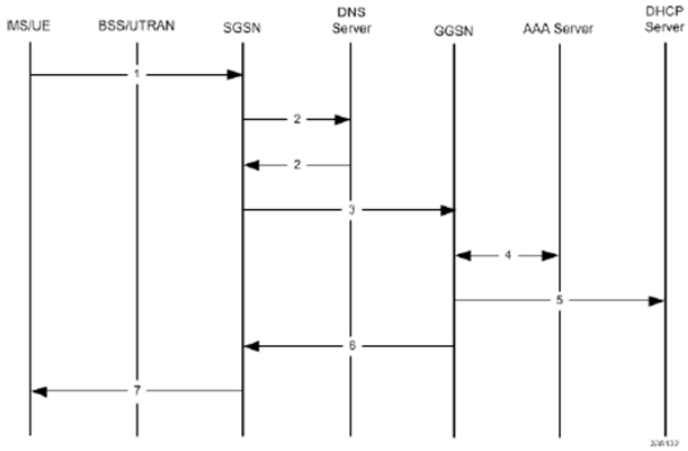


The following table provides detailed explanations for each step indicated in the figure above.

Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.</td></tr>
<tr><td colspan="2">**CLAIM 7**</td></tr>
<tr><td>**7[A]** The method according to claim 1, further comprising</td><td>Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 1, *see supra* 1[Pre.]-1[B], and further comprises receiving at the mobile station the Activate PDP Context Accept message containing the information relating to an assignment of either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message.</td></tr>
</table>

receiving at the mobile station the Activate PDP Context Accept message containing the information relating to an assignment of either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message.	**PDP Context Activation Procedures** The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. *Figure 9: Call Flow for PDP Context Activation*  The following table provides detailed explanations for each step indicated in the figure above. *Table 3: PDP Context Activation Procedure* **Step** | **Description** 1 | The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN). *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89. For example, as shown below, the SGSN sends the Activate PDP Context Accept message and IP address to the mobile station (MS).

Step	Description
5	If the MS/UE requires an IP address, the GGSN may allocate one dynamically via DHCP.
6	The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.
7	The SGSN sends a Activate PDP Context Accept message to the MS/UE along with the IP Address. Upon PDP Context Activation, the SGSN begins generating S-CDRs. The S-CDRs are updated periodically based on Charging Characteristics and trigger conditions. A GTP-U tunnel is now established and the MS/UE can send and receive data.

See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].

As discussed above, the IP address sent in the Create PDP Context Response message from the GGSN to the SGSN is based on the information contained in the APN field of the Create PDP Context Request message. The IP address can be either a public address or a private address. For example, see claim 1.

The DNS server provides a response to SGSN containing the private or public IP address of a GGSN to the SGSN in Step 2. For example, see 1[A].

The GGSN already has an APN Restriction value for each APN request by UE/MS. The GGSN checks whether the APN Restriction value received in the Create PDP Context Request from the SGSN and the APN Restriction value of the APN to which access is requested are the same. If the values are the same, the GGSN creates the PDP context and sends a create response message back to the SGSN containing the IP address assigned to the UE/MS in Step 6. The

	SGSN then sends an Activate PDP Context Accept message to the UE/MS in Step 7 along with the public or private IP address from GGSN. For example, "[d]uring default bearer activation the Gn/S4-SGSN sends the current Maximum APN Restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (if it is the first activation for that UE or if the APN Restriction is disabled, Maximum APN restriction will be "0" in the Create PDP Context Request/Create Session Request). The GGSN/P-GW has an APN restriction value for each APN. If the Maximum APN Restriction for the subscriber is received in the Create PDP Context Request/Create Session Request and APN Restriction value of the APN to which activation is being requested do not concur then the GGSN/P-GW rejects the activation by sending a Create PDP Context/Create Session Response failure message to the G/S4-SGSN with EGTP cause EGTP_CAUSE_INCOMPATIBLE_APN_REST_TYPE (0x68)." *Id*. at 184; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.
CLAIM 8	
8[A] The method according to claim 1, wherein in the receiving and sending, the information comprises one or more parameters that explicitly indicates requesting either a private network address or a public network address to be assigned to the mobile station.	Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 1, *see supra* 1[Pre.]-1[B], wherein in the receiving and sending, the information comprises one or more parameters that explicitly indicates requesting either a private network address or a public network address to be assigned to the mobile station. For example, the APN Restriction value, which determines the type of application data the subscriber can send, constitutes a parameter. "During default bearer activation, the SGSN sends the current maximum APN restriction value for the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request (CSR)." The "APN Restriction value corresponding to each APN is known by the GGSN/P-GW. The Gn/S4-SGSN sends the Maximum APN Restriction of the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request. The GGSN/P-GW accepts or rejects the activation based on the Maximum APN Restriction of UE and APN Restriction value of that APN which is sent the Create PDP Context Request/Create Session Request." WSOU-CISCO013800 at 183; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.

The APN Restriction values explicitly indicate the request for a private or public network address to be assigned to the mobile station. For example, when the "APN Restriction Value allowed to be established" is "1," then the "Private" APN for Corporate is assigned in the exemplary manner shown below.

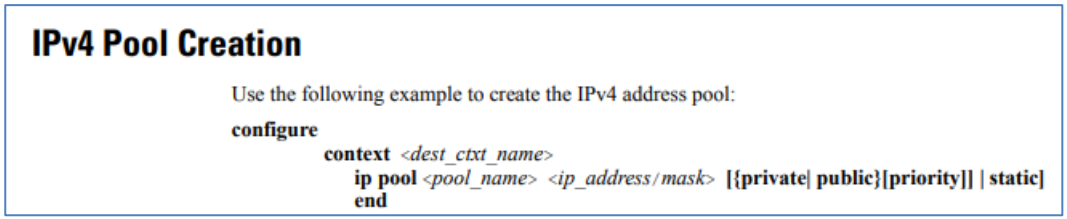
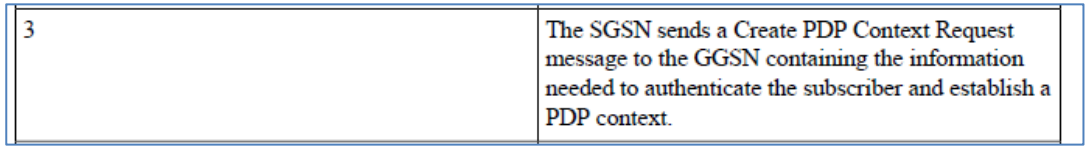
Table 13: APN restriction values

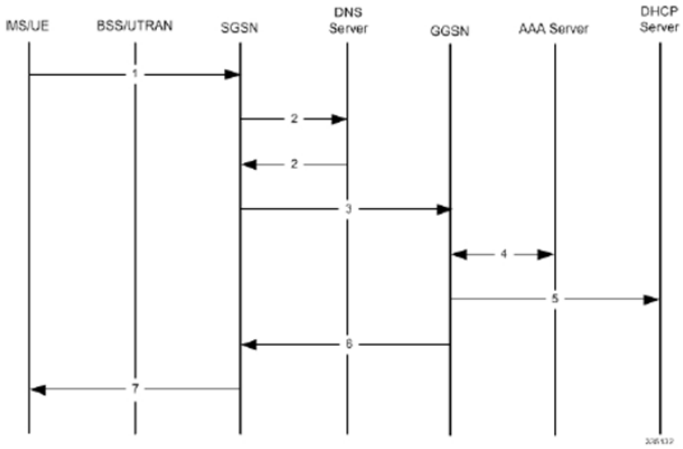
Maximum APN Restriction Value	Type of APN	Application Example	APN Restriction Value allowed to be established
0	No Existing Contexts or Restriction		All
1	Public-1	WAP or MMS	1, 2, 3
2	Public-2	Internet or PSPDN	1, 2
3	Private-1	Corporate (for example MMS subscribers)	1
4	Private-2	Corporate (for example non-MMS subscribers)	None

WSOU-CISCO013800 at 184.

"Before an MS is able to access data services, they must have an IP address. As described previously, the GGSN supports static or dynamic addressing (through locally configured address pools on the system, DHCP client-mode, or DHCP relay-mode). Regardless of the allocation method, a corresponding address pool must be configured." *See* WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 104]. To configure the IP pool:

Step 1	Create the IP pool for IPv4 addresses in system context by applying the example configuration in the *IPv4 Pool Creation* section.
Step 2	Optional. Configure the IP pool for IPv6 addresses in system context by applying the example configuration in the *IPv6 Pool Creation* section.
Step 3	Verify your IP pool configuration by following the steps in the *IP Pool Configuration Verification* section.
Step 4	Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.

	Id. at 105.  **IPv4 Pool Creation** Use the following example to create the IPv4 address pool: **configure** **context** *<dest_ctxt_name>* **ip pool** *<pool_name> <ip_address/mask>* **[{private| public}[priority]] | static]** **end** *Id*. at 106.
CLAIM 9	
9[Pre.] A method comprising:	To any extent the preamble is limiting, Cisco's Mobile Multimedia Gateway Platform practices a method comprising the following elements, as illustrated below.
9[A] receiving a Create Packet Data Protocol (PDP) Context Request message from a Serving General Packet Radio System (GPRS) Support Node (SGSN) at a Gateway General Packet Radio System (GPRS) Support Node (GGSN), the Create PDP Context Request Message having an APN	Cisco's Mobile Multimedia Gateway Platform practices a method that comprises receiving a Create Packet Data Protocol (PDP) Context Request message from a Serving General Packet Radio System (GPRS) Support Node (SGSN) at a Gateway General Packet Radio System (GPRS) Support Node (GGSN), the Create PDP Context Request Message having an APN (Access Point Name) field containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to a mobile station of the network. For example, as shown in Step 3 below, the SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context.  3 — The SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context. *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)].

(Access Point Name) field containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to a mobile station of the network;	**SGSN and Dual Access SGSN Deployments** SGSNs and GGSNs work in conjunction within the GPRS/UMTS network. As indicated earlier in the section on *System Configuration Options*, the flexible architecture of StarOS enables a single chassis to reduce hardware requirements by supporting integrated co-location of a variety of the SGSN services. *Id.* at 5. **PDP Context Activation Procedures** The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. ***Figure 9: Call Flow for PDP Context Activation***  The following table provides detailed explanations for each step indicated in the figure above. ***Table 3: PDP Context Activation Procedure*** **Step** | **Description** 1 | The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN). *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

The SGSN sends the Create PDP Context Request message that contains an APN field . For example, in the PDP Activation procedure, "[t]he SGSN sends a Create PDP Context Request message to the GGSN. This message identifies the APN the UE is attempting to connect to and other information about the subscriber." WSOU-CISCO013800 at 102.

1. A PDP Activation Request message is sent from the UE to the SGSN by the BSS over the Gb interface. This request includes the Access Point Name (APN) the UE is attempting to connect to. This is typically a Frame relay connection.
2. The SGSN queries the DNS server to resolve the APN to the IP address of the GGSN to use to establish the PDP context.
3. The SGSN sends a Create PDP Context Request message to the GGSN. This message identifies the APN the UE is attempting to connect to and other information about the subscriber.
4. The GGSN performs its processes for establishing the PDP context. This may include subscriber authentication, service provisioning, etc. The GGSN eventually sends an affirmative create PDP context response to the SGSN containing the IP address assigned to the UE.
5. The SGSN sends an Activate PDP Context Accept message back to the UE. The subscriber can now begin sending/receiving data.
6. The SGSN begins generating S-CDR data that will be sent to the CG.

See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 102 (Aug. 29, 2019)].

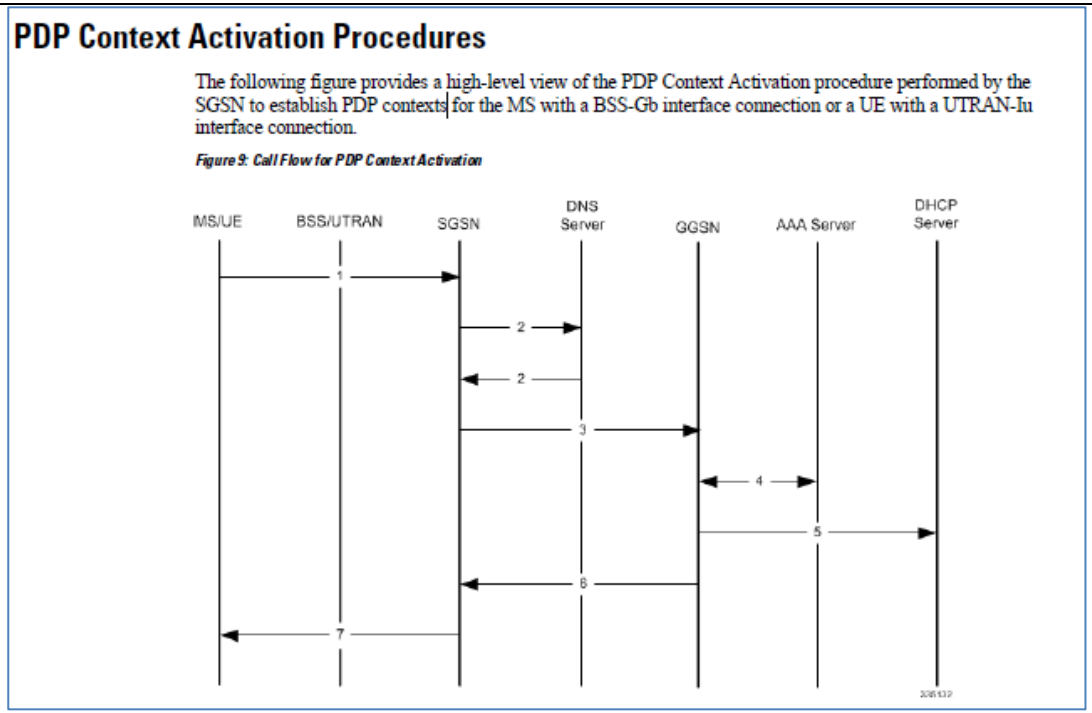
Further, the APN field in the Create PDP Context Request contains information relating to a request for either a private network address or a public network address for the mobile station. The APN field indicates requesting either a private network address of a public network address. The GGSN/P-GW has an APN restriction value for each APN, and each APN corresponds to either a public, or a private address, according to its associated APN restriction value. For example, see claims 1, 2[A].

Further, "[d]uring default bearer activation the Gn/S4-SGSN sends the current Maximum APN Restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (if it is the first activation for that UE or if the APN Restriction is disabled, Maximum APN restriction will be "0" in the Create PDP Context Request/Create Session Request). The GGSN/P-GW has an APN restriction value for each APN. If the Maximum APN Restriction for the subscriber is received in the Create PDP Context Request/Create Session Request and APN

	Restriction value of the APN to which activation is being requested do not concur then the GGSN/P-GW rejects the activation by sending a Create PDP Context/Create Session Response failure message to the G/S4-SGSN with EGTP cause EGTP_CAUSE_INCOMPATIBLE_APN_REST_TYPE (0x68)." WSOU-CISCO013800 at 184; *see* WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 94]; *see also* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf at 183 ("APN Restriction value corresponding to each APN is known by the GGSN/P-GW.")].
9[B] assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message; and	Cisco's Mobile Multimedia Gateway Platform practices a method that comprises assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message. The Create PDP Context Request contains an APN field containing information relating to a request for either a private network address or a public network address for the mobile station. For example, see 9[A]. As shown below, the mobile station is assigned an IP address (public or private) based on the information contained in the APN field of the Create PDP Context Request message. As discussed in 1[A], 1[B] and 2[A], the GGSN already has an APN Restriction value for each APN request by UE/MS. The GGSN checks whether the APN Restriction value received in the Create PDP Context Request from the SGSN and the APN Restriction value of the APN to which access is requested are the same. For example, "[d]uring default bearer activation the Gn/S4-SGSN sends the current Maximum APN Restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (if it is the first activation for that UE or if the APN Restriction is disabled, Maximum APN restriction will be "0" in the Create PDP Context Request/Create Session Request). The GGSN/P-GW has an APN restriction value for each APN. If the Maximum APN Restriction for the subscriber is received in the Create PDP Context Request/Create Session Request and APN Restriction value of the APN to which activation is being requested do not concur then the GGSN/P-GW rejects the activation by sending a Create PDP Context/Create Session Response failure message to the G/S4-SGSN with EGTP cause EGTP_CAUSE_INCOMPATIBLE_APN_REST_TYPE (0x68)." WSOU-CISCO013800 at 184. If the values are the same, the GGSN creates the PDP context and sends a create response message back to the SGSN containing the IP address assigned to the UE/MS in Step 6. The SGSN then sends an Activate PDP Context Accept message to the UE/MS in Step 7 along with the public or private IP address from GGSN.

Step	Description
5	If the MS/UE requires an IP address, the GGSN may allocate one dynamically via DHCP.
6	The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.
7	The SGSN sends a Activate PDP Context Accept message to the MS/UE along with the IP Address. Upon PDP Context Activation, the SGSN begins generating S-CDRs. The S-CDRs are updated periodically based on Charging Characteristics and trigger conditions. A GTP-U tunnel is now established and the MS/UE can send and receive data.

See WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].

	 *See, e.g.*, WSOU-CISCO013800 at 80; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.
9[C] sending the Create PDP Context Response message from the GGSN to the SGSN containing the information assigning either a private network address or a public	Cisco's Mobile Multimedia Gateway Platform practices a method that comprises sending the Create PDP Context Response message from the GGSN to the SGSN containing the information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message. For example, as shown below in Step 6, the GGSN sends a Create PDP Context Response message to the SGSN containing the IP address (public or private depending on the APN request) assigned to the mobile station.

network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message.

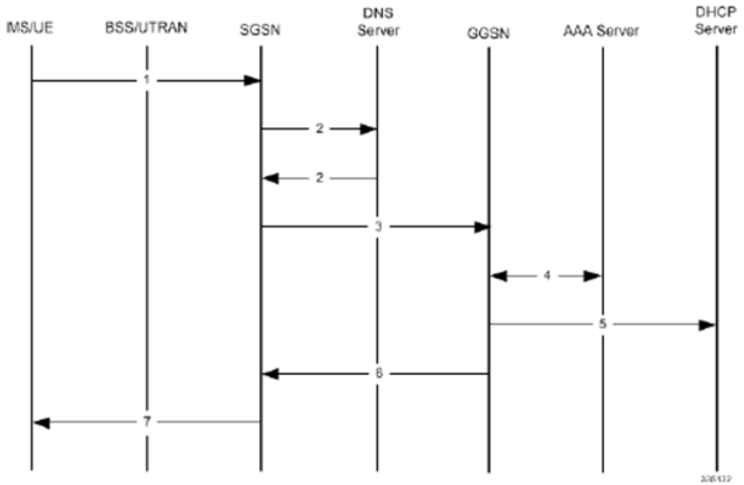
6	The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.

See WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation

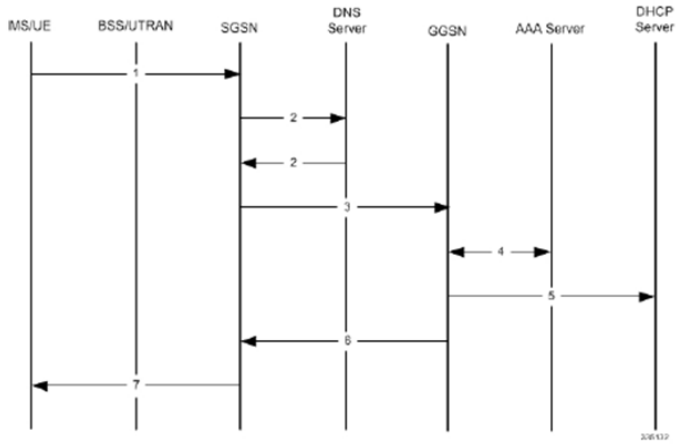


The following table provides detailed explanations for each step indicated in the figure above.

Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

	See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89. As discussed above, the IP address sent in the Create PDP Context Response message from the GGSN to the SGSN is based on the information contained in the APN field of the Create PDP Context Request message. The IP address can be either a public address or a private address. For example, see 3[C].
CLAIM 10	
10[Pre.] A method comprising:	To any extent the preamble is limiting, Cisco's Mobile Multimedia Gateway Platform practices a method comprising the following elements, as illustrated below.
10[A] receiving a Create Packet Data Protocol (PDP) Context Request message from a Serving General Packet Radio System (GPRS) Support Node (SGSN) at a Border Gateway (BG), the Create PDP Context Request Message having an APN (Access Point Name) field containing information that explicitly indicates	Cisco's Mobile Multimedia Gateway Platform practices a method that comprises receiving a Create Packet Data Protocol (PDP) Context Request message from a Serving General Packet Radio System (GPRS) Support Node (SGSN) at a Border Gateway (BG), the Create PDP Context Request Message having an APN (Access Point Name) field containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to a mobile station of a network. StarOS includes both "Standalone gateway GPRS support node (GGSN)" and "Co-located P-GW/GGSN" deployments and interfaces. On information and belief, Cisco's Mobile Multimedia Gateway Platform practices a method that includes receiving a Create PDP Context Request message from a Gateway General Packet Radio System (GPRS) Support Node (GGSN) at a Border Gateway (i.e., Packet Gateway: P-GW). *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 6-7 (Aug. 29, 2019)]. For example, "[d]uring default bearer activation, the SGSN sends the current maximum APN restriction value for the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send. If the maximum APN restriction of the UE (received in the CSR) and the APN Restriction value of the APN (for which activation is being requested) do not concur, then the GGSN/P-GW rejects

requesting either a private network address or a public network address to be assigned to a mobile station of a network;	activation. The maximum APN restriction for a UE is the most restrictive based on all already active default EPS bearers. The purpose of enabling APN Restriction in S4-SGSN is to determine whether the UE is allowed to establish EPS Bearers with other APNs based on the Maximum APN Restriction value associated with that UE." *Id.* at 23, 183-184; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379. Therefore, the following figure and table specifying the PDP Context Activation Procedures workflow, that involves sending a Create PDP Context Request message, applies for both the Gateway General Packet Radio System (GPRS) Support Node (GGSN) or to a co-located GGSN/P-GW, as well as the same APN Restriction feature. **PDP Context Activation Procedures** The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. ***Figure 9: Call Flow for PDP Context Activation***  The following table provides detailed explanations for each step indicated in the figure above. *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

	According to the graph above, SGSN sends a Create PDP Context Request message to a Gateway General Packet Radio System (GPRS) Support Node (GGSN) of the network, the Create PDP Context Request message having an APN field containing information relating to a request for either a private network address or a public network address for the mobile station. Given that the co-located GGSN/P-GW utilizes the same PDP Context Activation Procedures, in a workflow with co-located GGSN/P-GW , SGSN sends a Create PDP Context Request message to the P-GW, the Create PDP Context Request message having an APN field containing information relating to a request for either a private network address or a public network address for the mobile station. For example, as shown in Step 3 below, the P-GW receives a Create Packet Data Protocol (PDP) Context Request message FROM SGSN, the Create PDP Context Request Message having an APN (Access Point Name) field containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to a mobile station of a network. In the same PDP Context Activation Procedures involving a co-located GGSN/P-GW, P-GW receives a Create Packet Data Protocol (PDP) Context Request message FROM SGSN, the Create PDP Context Request Message having an APN (Access Point Name) field containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to a mobile station of a network. 3 — The SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context. WSOU-CISCO013800 at 80. **SGSN and Dual Access SGSN Deployments** SGSNs and GGSNs work in conjunction within the GPRS/UMTS network. As indicated earlier in the section on *System Configuration Options*, the flexible architecture of StarOS enables a single chassis to reduce hardware requirements by supporting integrated co-location of a variety of the SGSN services. *Id*. at 5.

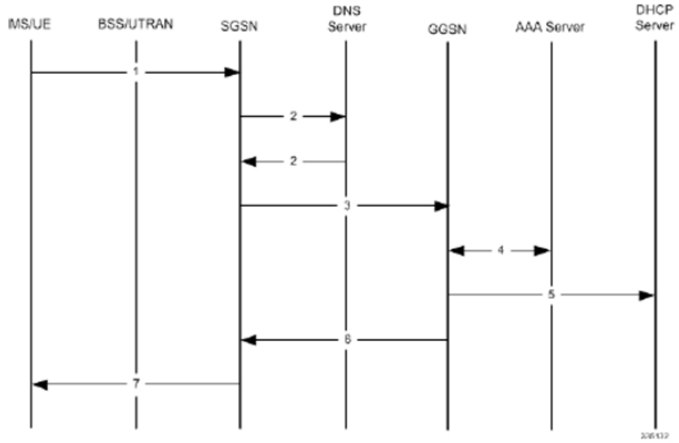
	The SGSN sends the APN Restriction value for the UE to the GGSN in the Create PDP Context Request. For example, "[d]uring default bearer activation the Gn/S4-SGSN sends the current Maximum APN Restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (if it is the first activation for that UE or if the APN Restriction is disabled, Maximum APN restriction will be "0" in the Create PDP Context Request/Create Session Request). The GGSN/P-GW has an APN restriction value for each APN. If the Maximum APN Restriction for the subscriber is received in the Create PDP Context Request/Create Session Request and APN Restriction value of the APN to which activation is being requested do not concur then the GGSN/P-GW rejects the activation by sending a Create PDP Context/Create Session Response failure message to the G/S4-SGSN with EGTP cause EGTP_CAUSE_INCOMPATIBLE_APN_REST_TYPE (0x68)." *Id.* at 184; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379; WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 94]; WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf at 183 ("APN Restriction value corresponding to each APN is known by the GGSN/P-GW.")].
10[B] assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message and	Cisco's Mobile Multimedia Gateway Platform practices a method that comprises assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message. For example, "[d]uring default bearer activation, the SGSN sends the current maximum APN restriction value for the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send. If the maximum APN restriction of the UE (received in the CSR) and the APN Restriction value of the APN (for which activation is being requested) do not concur, then the GGSN/P-GW rejects activation. The maximum APN restriction for a UE is the most restrictive based on all already active default EPS bearers. The purpose of enabling APN Restriction in S4-SGSN is to determine whether the UE is allowed to establish EPS Bearers with other APNs based on the Maximum APN Restriction value associated with that UE." *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 23, 183-84. (Aug. 29, 2019)].

Therefore, the following figure and table specifying the PDP Context Activation Procedures workflow, that involves sending a Create PDP Context Request message, applies for both the Gateway General Packet Radio System (GPRS) Support Node (GGSN) or to a co-located GGSN/P-GW, as well as the same APN Restriction feature.

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

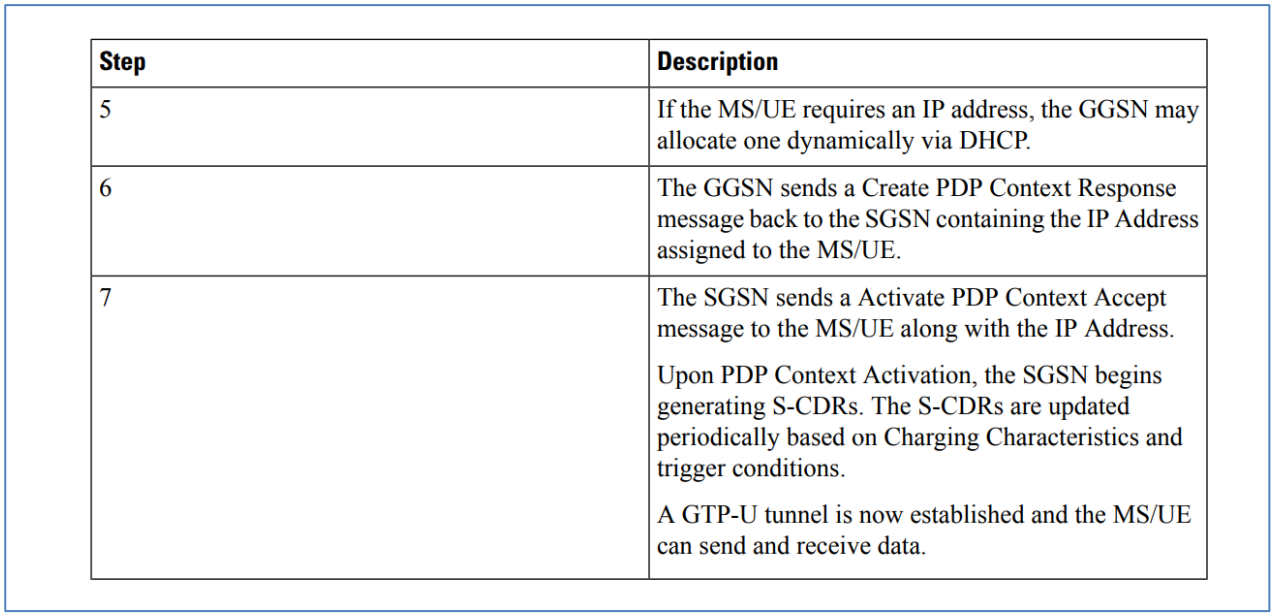
Figure 9: Call Flow for PDP Context Activation

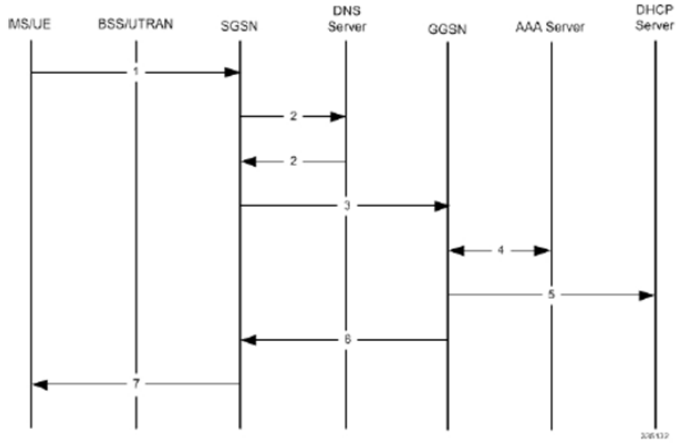


The following table provides detailed explanations for each step indicated in the figure above.

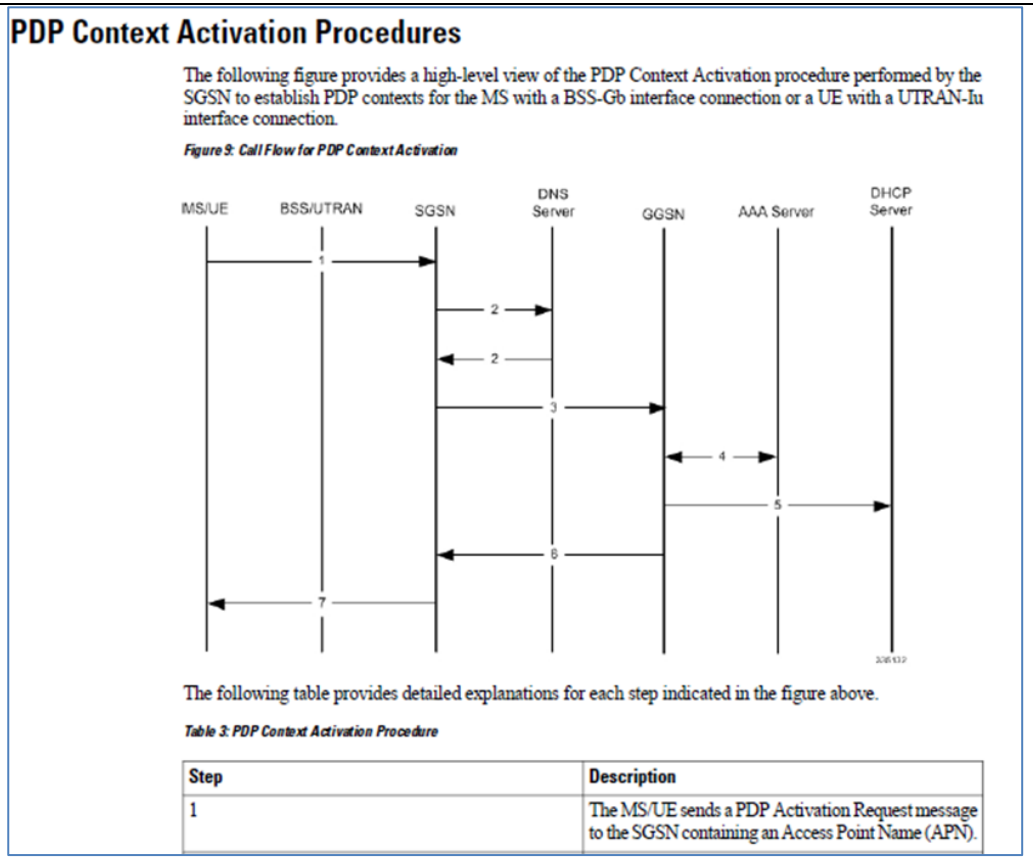
See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

As discussed in to 3[B], for example, and as shown below, the mobile station is assigned an IP address (public or private) based on the information contained in the APN field of the Create PDP Context Request message. Given that the co-located GGSN/P-GW utilizes the same PDP Context Activation Procedures, in a workflow with co-located GGSN/P-GW, the mobile station is also assigned an IP address based on the information contained in the APN field of the Create PDP Context Request message. The IP address could be either a public address, or a private address.

	 | Step	Description
5	If the MS/UE requires an IP address, the GGSN may allocate one dynamically via DHCP.
6	The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.
7	The SGSN sends a Activate PDP Context Accept message to the MS/UE along with the IP Address. Upon PDP Context Activation, the SGSN begins generating S-CDRs. The S-CDRs are updated periodically based on Charging Characteristics and trigger conditions. A GTP-U tunnel is now established and the MS/UE can send and receive data. | *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].
10[C] sending the Create PDP Context Response message from the BG to the SGSN containing the information assigning either a private network address or a public network address to the mobile station	Cisco's Mobile Multimedia Gateway Platform practices a method that comprises sending the Create PDP Context Response message from the BG to the SGSN containing the information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message. For example, "[d]uring default bearer activation, the SGSN sends the current maximum APN restriction value for the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send. If the maximum APN restriction of the UE (received in the CSR) and the APN Restriction value of the APN (for which activation is being requested) do not concur, then the GGSN/P-GW rejects activation. The maximum APN restriction for a UE is the most restrictive based on all already active default EPS

based on the information contained in the APN field of the Create PDP Context Request message.	bearers. The purpose of enabling APN Restriction in S4-SGSN is to determine whether the UE is allowed to establish EPS Bearers with other APNs based on the Maximum APN Restriction value associated with that UE." *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 23, 183-84 (Aug. 29, 2019)]. Therefore, the following figure and table specifying the PDP Context Activation Procedures workflow, that involves sending a Create PDP Context Request message, applies for both the Gateway General Packet Radio System (GPRS) Support Node (GGSN) or to a co-located GGSN/P-GW, as well as the same APN Restriction feature. **PDP Context Activation Procedures** The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. ***Figure 9: Call Flow for PDP Context Activation***  The following table provides detailed explanations for each step indicated in the figure above. *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

	As discussed in 3[C], and as shown below in Step 6, the SGSN is sent a Create PDP Context Response message containing the IP address (public or private depending on the APN request) assigned to the mobile station. Given that the co-located GGSN/P-GW utilizes the same PDP Context Activation Procedures, in a workflow with co-located GGSN/P-GW, the SGSN is also sent a Create PDP Context Response message containing the IP address assigned to the mobile station. The IP address could be either a public address, or a private address, depending on the APN request. 6 — The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE. *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].



PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation

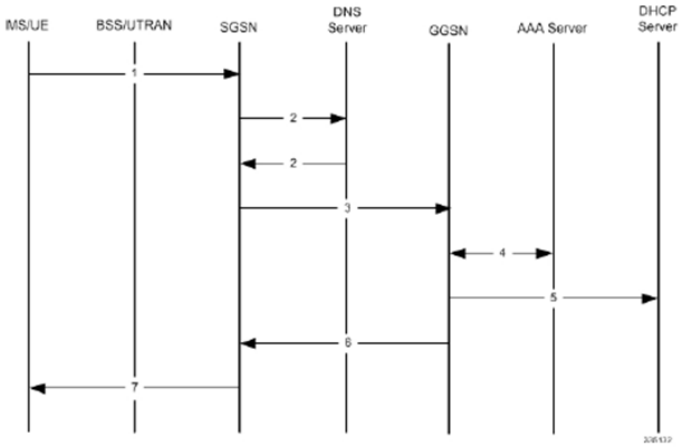
The following table provides detailed explanations for each step indicated in the figure above.

Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

See, e.g., *id.* at 80; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

CLAIM 11	
11[Pre.] A method comprising:	To any extent the preamble is limiting, Cisco's Mobile Multimedia Gateway Platform practices a method that comprises the following elements, as illustrated below.

11[A] sending an Activate Packet Data Protocol (PDP) Context Request message to a Serving General Packet Radio System (GPRS) Support Node (SGSN) of a network from a mobile station of the network, the Activate PDP Context Request message having an APN (Access Point Name) field containing information containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to the mobile station; and	Cisco's Mobile Multimedia Gateway Platform practices a method that comprises sending an Activate Packet Data Protocol (PDP) Context Request message to a Serving General Packet Radio System (GPRS) Support Node (SGSN) of a network from a mobile station of the network, the Activate PDP Context Request message having an APN (Access Point Name) field containing information containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to the mobile station. For example, as shown below in Step 1, a mobile station (MS, or UE "User Equipment") sends a PDP Activation Request message containing an APN field to SGSN. **PDP Context Activation Procedures** The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. *Figure 9: Call Flow for PDP Context Activation*  The following table provides detailed explanations for each step indicated in the figure above. *Table 3: PDP Context Activation Procedure* **Step** | **Description** 1 | The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN). *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80

(Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

The APN indicates requesting either a private network address of a public network address. The GGSN/P-GW has an APN restriction value for each APN. The APN Restriction values explicitly indicate the request for a private or public network address to be assigned to the mobile station. For example, when the "APN Restriction Value allowed to be established" is "1" then the "Private" APN for Corporate is assigned in the exemplary manner shown below.

Table 13: APN restriction values

Maximum APN Restriction Value	Type of APN	Application Example	APN Restriction Value allowed to be established
0	No Existing Contexts or Restriction		All
1	Public-1	WAP or MMS	1, 2, 3
2	Public-2	Internet or PSPDN	1, 2
3	Private-1	Corporate (for example MMS subscribers)	1
4	Private-2	Corporate (for example non-MMS subscribers)	None

See WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf at 184].

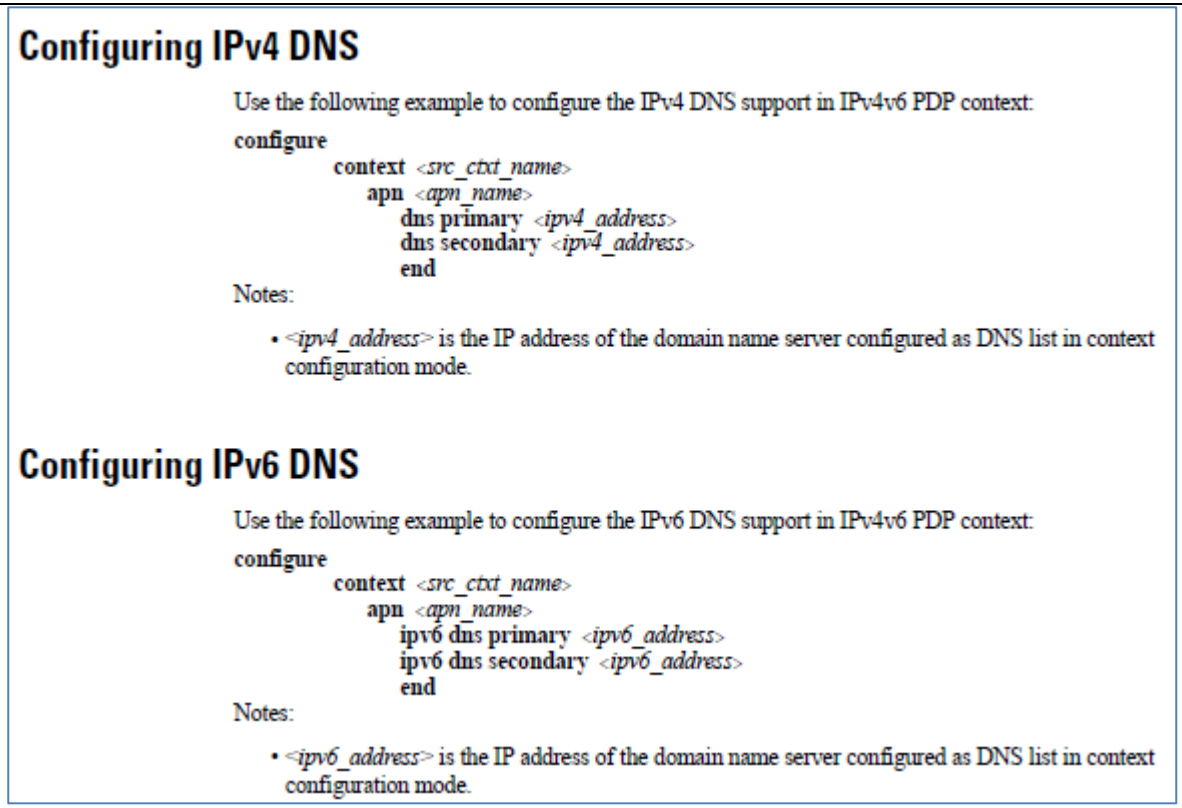
"During default bearer activation, the SGSN sends the current Maximum APN restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send." This indicates that each APN corresponds to either a public, or a private address, according to its associated APN restriction value. For example, the "APN Restriction value corresponding to each APN is known by the GGSN/P-GW. The Gn/S4-SGSN sends the Maximum APN Restriction of the UE ["User Equipment"] to the GGSN/P-GW in a Create PDP Context Request/Create Session Request. The GGSN/P-GW accepts or rejects the activation based on the Maximum APN Restriction of UE and APN Restriction value of that APN which is sent the Create PDP Context Request/Create Session Request... This feature provides the operator with

increased control to restrict certain APNs to UEs based on the type of APN." *Id.* at 183-184; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.

Therefore, an Activate PDP Context Request message is sent to SGSN from a mobile station of the network, the Activate PDP Context Request message having an APN field containing information containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to the mobile station. After the SGSN receives the Activate PDP Context Request message in Step 1, the SGSN sends a DNS query to resolve the APN provided by the Mobile Station to a GGSN address in Step 2. The DNS server provides a response containing the private or public IP address of a GGSN to the SGSN.'

2	The SGSN sends a DNS query to resolve the APN provided by the MS/UE to a GGSN address. The DNS server provides a response containing the IP address of a GGSN.

See WSOU-CISCO013800 at 80. The below shows configurations of IPv4 and IPv6 DNS.



Configuring IPv4 DNS

Use the following example to configure the IPv4 DNS support in IPv4v6 PDP context:

```
configure
    context <src_ctxt_name>
        apn <apn_name>
            dns primary <ipv4_address>
            dns secondary <ipv4_address>
            end
```

Notes:

- <*ipv4_address*> is the IP address of the domain name server configured as DNS list in context configuration mode.

Configuring IPv6 DNS

Use the following example to configure the IPv6 DNS support in IPv4v6 PDP context:

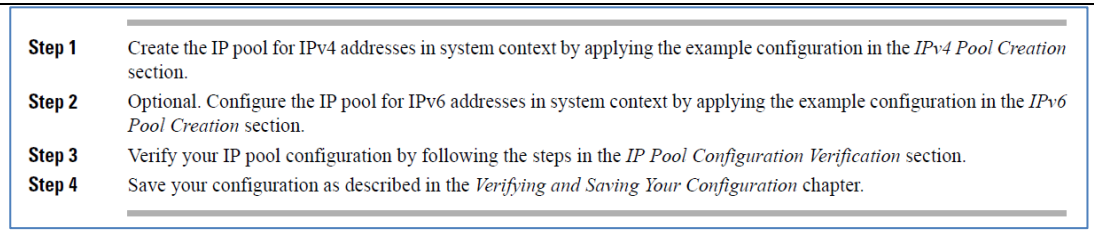
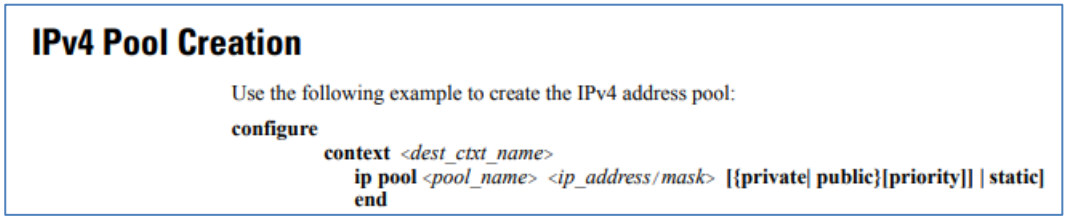
```
configure
    context <src_ctxt_name>
        apn <apn_name>
            ipv6 dns primary <ipv6_address>
            ipv6 dns secondary <ipv6_address>
            end
```

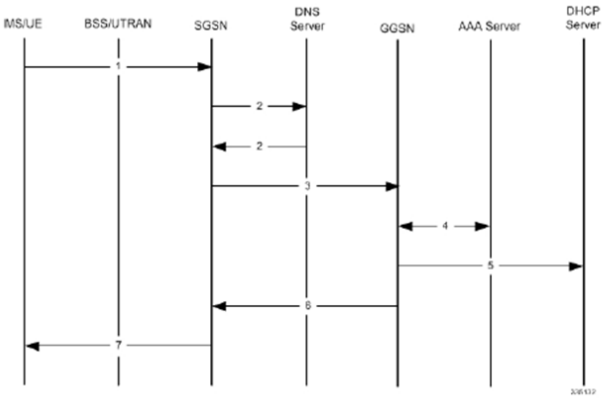
Notes:

- <*ipv6_address*> is the IP address of the domain name server configured as DNS list in context configuration mode.

See WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 104].

"Before an MS is able to access data services, they must have an IP address. As described previously, the GGSN supports static or dynamic addressing (through locally configured address pools on the system, DHCP client-mode, or DHCP relay-mode). Regardless of the allocation method, a corresponding address pool must be configured." *See* WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-a 3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 104 (April 27, 2017)]. To configure the IP pool:

	 **Step 1** Create the IP pool for IPv4 addresses in system context by applying the example configuration in the *IPv4 Pool Creation* section. **Step 2** Optional. Configure the IP pool for IPv6 addresses in system context by applying the example configuration in the *IPv6 Pool Creation* section. **Step 3** Verify your IP pool configuration by following the steps in the *IP Pool Configuration Verification* section. **Step 4** Save your configuration as described in the *Verifying and Saving Your Configuration* chapter. *Id.* at 105.  **IPv4 Pool Creation** Use the following example to create the IPv4 address pool: **configure** **context** *<dest_ctxt_name>* **ip pool** *<pool_name>* *<ip_address/mask>* **[{private| public}[priority]] | static]** **end** *Id.* at 106.
11[B] receiving at the mobile station an Activate PDP Context Accept message containing information relating to an assignment of either a private network address or a public network address to the mobile station based on the information contained in the APN field of the	Cisco's Mobile Multimedia Gateway Platform practices a method that comprises receiving at the mobile station an Activate PDP Context Accept message containing information relating to an assignment of either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message.

Activate PDP Context Request message.	**PDP Context Activation Procedures** The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. ***Figure 9: Call Flow for PDP Context Activation***  The following table provides detailed explanations for each step indicated in the figure above. ***Table 3: PDP Context Activation Procedure*** **Step** | **Description** 1 | The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN). *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89. For example, as shown below in Step 7, the SGSN sends the Activate PDP Context Accept message to the mobile station (MS) along with the IP Address.

7	The SGSN sends a Activate PDP Context Accept message to the MS/UE along with the IP Address. Upon PDP Context Activation, the SGSN begins generating S-CDRs. The S-CDRs are updated periodically based on Charging Characteristics and trigger conditions. A GTP-U tunnel is now established and the MS/UE can send and receive data.

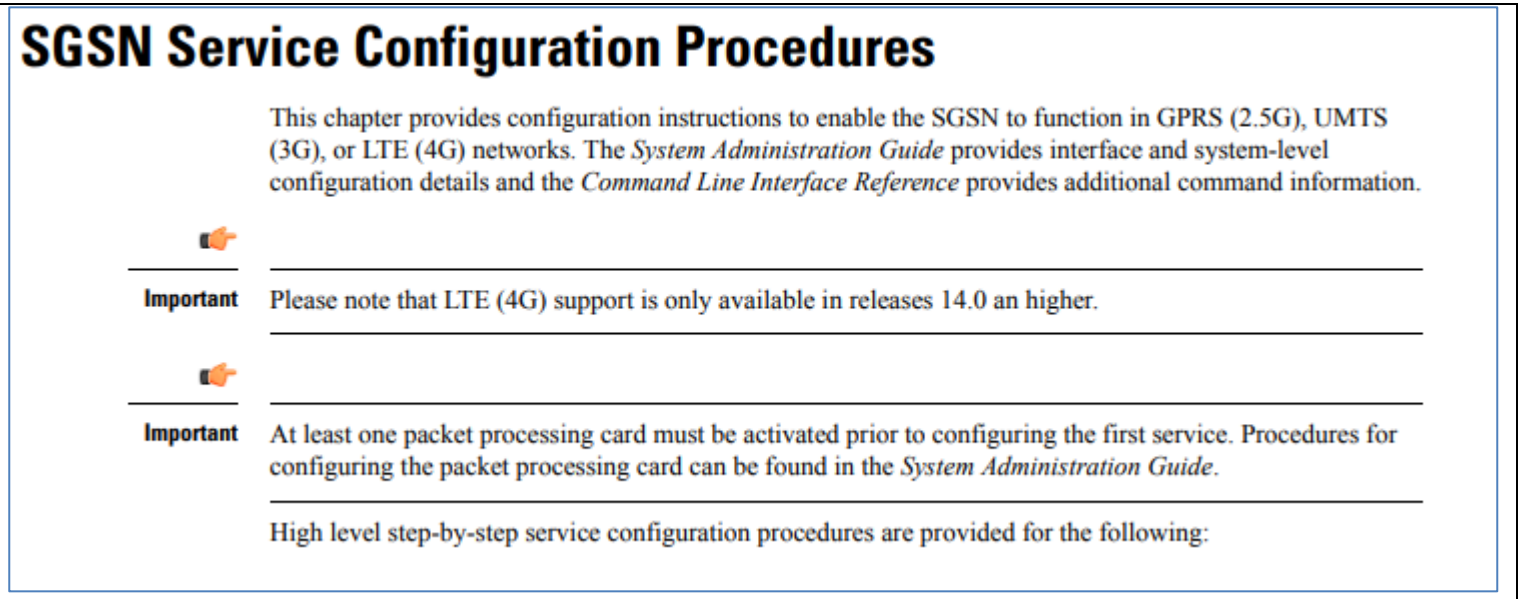
See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].

The DNS server provides a response to SGSN containing the private or public IP address of a GGSN to the SGSN in Step 2. For example, see 1[A]. The GGSN already has an APN Restriction value for each APN request by UE/MS. The GGSN checks whether the APN Restriction value received in the Create PDP Context Request from the SGSN and the APN Restriction value of the APN to which access is requested are the same. If the values are the same, the GGSN creates the PDP context and sends a create response message back to the SGSN containing the IP address assigned to the UE/MS in Step 6. The SGSN then sends an Activate PDP Context Accept message to the UE/MS in Step 7 along with the public or private IP address from GGSN.

For example, "[d]uring default bearer activation the Gn/S4-SGSN sends the current Maximum APN Restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (if it is the first activation for that UE or if the APN Restriction is disabled, Maximum APN restriction will be "0" in the Create PDP Context Request/Create Session Request). The GGSN/P-GW has an APN restriction value for each APN. If the Maximum APN Restriction for the subscriber is received in the Create PDP Context Request/Create Session Request and APN Restriction value of the APN to which activation is being requested do not concur then the GGSN/P-GW rejects the activation by sending a Create PDP Context/Create Session Response failure message to the G/S4-SGSN with EGTP cause EGTP_CAUSE_INCOMPATIBLE_APN_REST_TYPE (0x68)." *Id.* at 184; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.

CLAIM 12	
12[A] The method according to claim 11, wherein the private network address and the public network address are each one of an IPv4 network address and an IPv6 network address.	Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 11, *see supra* 11[Pre.]-11[B], wherein the private network address and the public network address are each one of an IPv4 network address and an IPv6 network address. For example, Cisco's Mobile Multimedia Gateway Platform practices a method of creating an IP pool for IPv4 addresses in system context and configuring the IP pool for IPv6 addresses in system context. **Step 1** Create the IP pool for IPv4 addresses in system context by applying the example configuration in the *IPv4 Pool Creation* section. **Step 2** Optional. Configure the IP pool for IPv6 addresses in system context by applying the example configuration in the *IPv6 Pool Creation* section. **Step 3** Verify your IP pool configuration by following the steps in the *IP Pool Configuration Verification* section. **Step 4** Save your configuration as described in the *Verifying and Saving Your Configuration* chapter. *See* WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 105]. **IPv4 Pool Creation** Use the following example to create the IPv4 address pool: **configure** **context** *<dest_ctxt_name>* **ip pool** *<pool_name>* *<ip_address/mask>* **[{private| public}[priority]] | static]** **end** *Id*. at 106.
CLAIM 13	
13[A] The method according to claim 11, wherein the	Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 11, *see supra* 11[Pre.]-11[B], wherein the network is a GPRS communications network.

network is a GPRS communications network.	Cisco's Mobile Multimedia Gateway Platform includes a GPRS communications network. For example: "StarOS provides a highly flexible and efficient Serving GPRS Support Node (SGSN) service to the wireless carriers. Functioning as an SGSN, the system readily handles wireless data services within 2.5G General Packet Radio Service (GPRS) and 3G Universal Mobile Telecommunications System (UMTS) data networks. The SGSN also can serve as an interface between GPRS and/or UMTS networks and the 4G Evolved Packet Core (EPC) network." *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 5].
CLAIM 14	
14[A] The method according to claim 11, wherein the network is a Universal Mobile Telecommunications System.	Cisco's Mobile Multimedia Gateway Platform practices the method according to claim 11, *see supra* 11[Pre.]-11[B], wherein the network is a Universal Mobile Telecommunications System. Cisco's Mobile Multimedia Gateway Platform includes a network that is a Universal Mobile Telecommunications system. For example: "StarOS provides a highly flexible and efficient Serving GPRS Support Node (SGSN) service to the wireless carriers. Functioning as an SGSN, the system readily handles wireless data services within 2.5G General Packet Radio Service (GPRS) and 3G Universal Mobile Telecommunications System (UMTS) data networks. The SGSN also can serve as an interface between GPRS and/or UMTS networks and the 4G Evolved Packet Core (EPC) network." *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 5].
CLAIM 15	
15[Pre.] An apparatus comprising a processor and a memory storing instructions that, when executed, the apparatus is configured to:	To any extent the preamble is limiting, Cisco's Mobile Multimedia Gateway Platform includes an apparatus comprising a processor and a memory storing instructions that, when executed, the apparatus is configured to perform the functions described in the following elements, as shown below.



SGSN Service Configuration Procedures

This chapter provides configuration instructions to enable the SGSN to function in GPRS (2.5G), UMTS (3G), or LTE (4G) networks. The *System Administration Guide* provides interface and system-level configuration details and the *Command Line Interface Reference* provides additional command information.

Important Please note that LTE (4G) support is only available in releases 14.0 an higher.

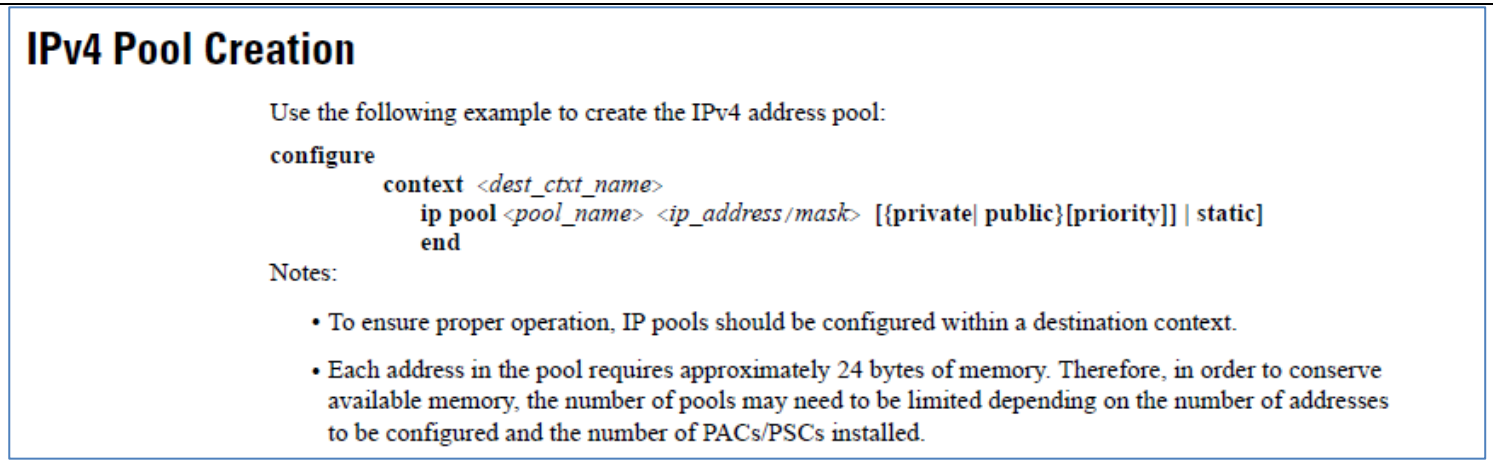
Important At least one packet processing card must be activated prior to configuring the first service. Procedures for configuring the packet processing card can be found in the *System Administration Guide*.

High level step-by-step service configuration procedures are provided for the following:

WSOU-CISCO013800 at 118.

For example, "[t]he SGSN is designed to accommodate a very high rate of simultaneous attaches. The actual attach rate depends on the latencies introduced by the network and scaling of peers. In order to optimize the entire signaling chain, the SGSN eliminates or minimizes bottlenecks caused by large scale control signaling. For this purpose, the SGSN implements features such as an in-memory data-VLR and SuperCharger. Both IMSI and P-TMSI based attaches are supported." *Id.* at 15.

Further, "[t]he SGSN authenticates the subscriber via the authentication procedure. This procedure is invoked on attaches, PDP activations, inter-SGSN routing Area Updates (RAUs), and optionally by configuration for periodic RAUs. The procedure requires the SGSN to retrieve authentication quintets/triplets from the HLR (AuC) and issuing an authentication and ciphering request to the MN. The SGSN implements an in-memory data-VLR functionality to pre-fetch and store authentication vectors from the HLR. This decreases latency of the control procedures." *Id.* at 16.

	 **IPv4 Pool Creation** Use the following example to create the IPv4 address pool: **configure** **context** *<dest_ctxt_name>* **ip pool** *<pool_name>* *<ip_address/mask>* **[{private| public}[priority]] | static]** **end** Notes: • To ensure proper operation, IP pools should be configured within a destination context. • Each address in the pool requires approximately 24 bytes of memory. Therefore, in order to conserve available memory, the number of pools may need to be limited depending on the number of addresses to be configured and the number of PACs/PSCs installed. *See* WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 106 (April 27, 2017)].
15[A] receive an Activate Packet Data Protocol (PDP) Context Request message from a mobile station of a network, the Activate PDP Context Request message having an APN (Access Point Name) field containing information that explicitly indicates requesting either a	Cisco's Mobile Multimedia Gateway Platform includes an apparatus configured to receive an Activate Packet Data Protocol (PDP) Context Request message from a mobile station of a network, the Activate PDP Context Request message having an APN (Access Point Name) field containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to the mobile station. For example, as shown below in Step 1, the SGSN receives a PDP Activation Request message from a mobile station (MS, or UE "User Equipment") containing an APN field.

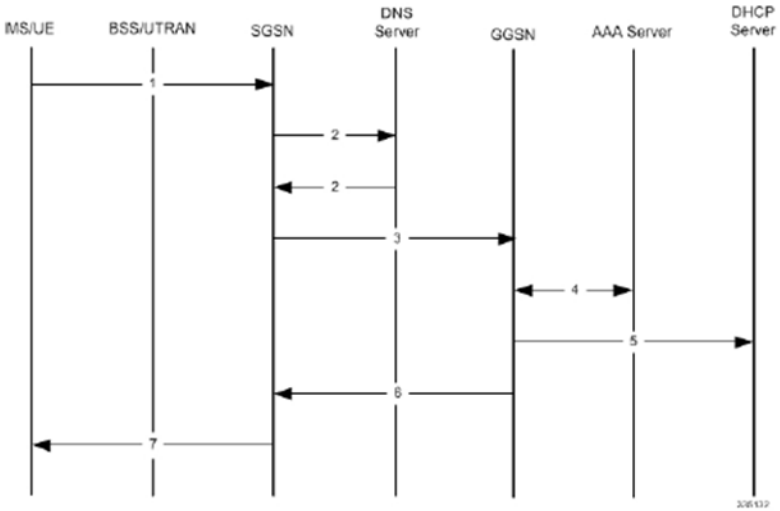
private network address or a public network address to be assigned to the mobile station; and	**PDP Context Activation Procedures** The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. ***Figure 9: Call Flow for PDP Context Activation***  The following table provides detailed explanations for each step indicated in the figure above. ***Table 3: PDP Context Activation Procedure*** **Step** | **Description** 1 | The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN). *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89. The APN indicates requesting either a private network address of a public network address. The GGSN/P-GW has an APN restriction value for each APN. The APN Restriction values explicitly indicate the request for a private or public network address to be assigned to the mobile station. For example, when the "APN Restriction Value allowed to be established" is "1" then the "Private" APN for Corporate is assigned in the exemplary manner shown below.

Table 13: APN restriction values

Maximum APN Restriction Value	Type of APN	Application Example	APN Restriction Value allowed to be established
0	No Existing Contexts or Restriction		All
1	Public-1	WAP or MMS	1, 2, 3
2	Public-2	Internet or PSPDN	1, 2
3	Private-1	Corporate (for example MMS subscribers)	1
4	Private-2	Corporate (for example non-MMS subscribers)	None

See WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf at 184].

"During default bearer activation, the SGSN sends the current Maximum APN restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send." This indicates that each APN corresponds to either a public, or a private address, according to its associated APN restriction value. For example, the "APN Restriction value corresponding to each APN is known by the GGSN/P-GW. The Gn/S4-SGSN sends the Maximum APN Restriction of the UE ["User Equipment"] to the GGSN/P-GW in a Create PDP Context Request/Create Session Request. The GGSN/P-GW accepts or rejects the activation based on the Maximum APN Restriction of UE and APN Restriction value of that APN which is sent the Create PDP Context Request/Create Session Request... This feature provides the operator with increased control to restrict certain APNs to UEs based on the type of APN." *Id.* at 183-184; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.

After the SGSN receives the Activate PDP Context Request message in Step 1, the SGSN sends a DNS query to resolve the APN provided by the Mobile Station to a GGSN address in Step 2. The DNS server provides a response containing the private or public IP address of a GGSN to the SGSN.

2	The SGSN sends a DNS query to resolve the APN provided by the MS/UE to a GGSN address. The DNS server provides a response containing the IP address of a GGSN.

WSOU-CISCO013800 at 80. The below shows configurations of IPv4 and IPv6 DNS.

Configuring IPv4 DNS

Use the following example to configure the IPv4 DNS support in IPv4v6 PDP context:

```
configure
        context <src_ctxt_name>
            apn <apn_name>
                dns primary <ipv4_address>
                dns secondary <ipv4_address>
                end
```

Notes:

- <*ipv4_address*> is the IP address of the domain name server configured as DNS list in context configuration mode.

Configuring IPv6 DNS

Use the following example to configure the IPv6 DNS support in IPv4v6 PDP context:

```
configure
        context <src_ctxt_name>
            apn <apn_name>
                ipv6 dns primary <ipv6_address>
                ipv6 dns secondary <ipv6_address>
                end
```

Notes:

- <*ipv6_address*> is the IP address of the domain name server configured as DNS list in context configuration mode.

	See WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 104]. "Before an MS is able to access data services, they must have an IP address. As described previously, the GGSN supports static or dynamic addressing (through locally configured address pools on the system, DHCP client-mode, or DHCP relay-mode). Regardless of the allocation method, a corresponding address pool must be configured." *Id.* To configure the IP pool: **Step 1** Create the IP pool for IPv4 addresses in system context by applying the example configuration in the *IPv4 Pool Creation* section. **Step 2** Optional. Configure the IP pool for IPv6 addresses in system context by applying the example configuration in the *IPv6 Pool Creation* section. **Step 3** Verify your IP pool configuration by following the steps in the *IP Pool Configuration Verification* section. **Step 4** Save your configuration as described in the *Verifying and Saving Your Configuration* chapter. *Id.* at 105. **IPv4 Pool Creation** Use the following example to create the IPv4 address pool: **configure** **context** *<dest_ctxt_name>* **ip pool** *<pool_name> <ip_address/mask>* **[{private| public}[priority]] | static]** **end** *Id.* at 106.
15[B] send an Activate PDP Context Accept message to the mobile station containing information	Cisco's Mobile Multimedia Gateway Platform includes an apparatus configured to send an Activate PDP Context Accept message to the mobile station containing information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message. For example, as shown below in Step 7, the SGSN sends the Activate PDP Context Accept message to the mobile station (MS) along with the IP Address.

assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message.	

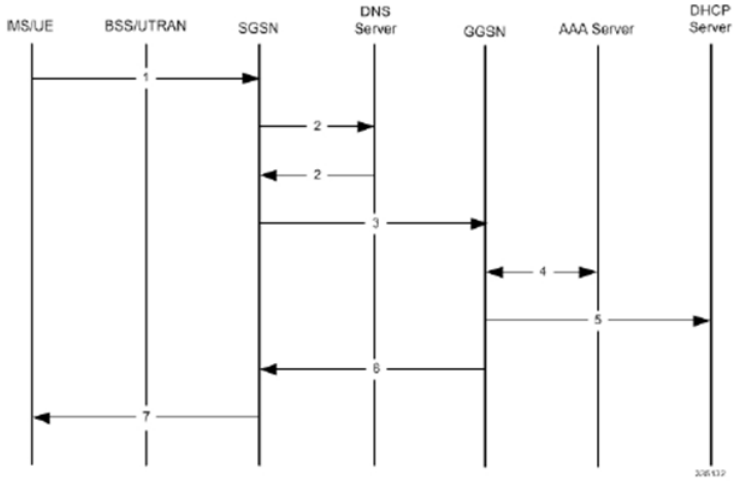
7	The SGSN sends a Activate PDP Context Accept message to the MS/UE along with the IP Address. Upon PDP Context Activation, the SGSN begins generating S-CDRs. The S-CDRs are updated periodically based on Charging Characteristics and trigger conditions. A GTP-U tunnel is now established and the MS/UE can send and receive data.

See WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

See, e.g., id. at 80; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

3	The SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context.
4	If required, the GGSN performs authentication of the subscriber.

WSOU-CISCO013800 at 80.

5	If the MS/UE requires an IP address, the GGSN may allocate one dynamically via DHCP.
6	The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.

Id. at 81.

The DNS server provides a response to SGSN containing the private or public IP address of a GGSN to the SGSN in Step 2. For example, see 1[A].

The GGSN already has an APN Restriction value for each APN request by UE/MS. The GGSN checks whether the APN Restriction value received in the Create PDP Context Request from the SGSN and the APN Restriction value of the APN to which access is requested are the same. If the values are the same, the GGSN creates the PDP context and sends a create response message back to the SGSN containing the IP address assigned to the UE/MS in Step 6. The SGSN then sends an Activate PDP Context Accept message to the UE/MS in Step 7 along with the public or private IP address from GGSN.

For example, "[d]uring default bearer activation the Gn/S4-SGSN sends the current Maximum APN Restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (if it is the first activation

	for that UE or if the APN Restriction is disabled, Maximum APN restriction will be "0" in the Create PDP Context Request/Create Session Request). The GGSN/P-GW has an APN restriction value for each APN. If the Maximum APN Restriction for the subscriber is received in the Create PDP Context Request/Create Session Request and APN Restriction value of the APN to which activation is being requested do not concur then the GGSN/P-GW rejects the activation by sending a Create PDP Context/Create Session Response failure message to the G/S4-SGSN with EGTP cause EGTP_CAUSE_INCOMPATIBLE_APN_REST_TYPE (0x68)." *Id*. at 184; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.
CLAIM 16	
16[A] The apparatus according to claim 15, wherein the instructions, when executed, the apparatus is configured to: send a Create PDP Context Request to a Gateway General Packet Radio System (GPRS) Support Node (GGSN) of the network, the Create PDP Context Request message having an APN field containing information relating to a request for either a private	Cisco's Mobile Multimedia Gateway Platform includes the apparatus according to claim 15, *see supra* 15[Pre.]-15[B], wherein the instructions, when executed, the apparatus is configured to: send a Create PDP Context Request to a Gateway General Packet Radio System (GPRS) Support Node (GGSN) of the network, the Create PDP Context Request message having an APN field containing information relating to a request for either a private network address or a public network address for the mobile station. For example, as shown in Step 3 below, the SGSN sends a Create PDP Context Request to the GGSN, which works in conjunction with the SGSN to identify the APN the mobile station is attempting to connect to and other information about the subscriber. The SGSN sends an APN Restriction value (Maximum APN Restriction) in the Create PDP Context Request for establishing a PDP context. 3 — The SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context. *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)].

network address or a public network address for the mobile station; and

SGSN and Dual Access SGSN Deployments

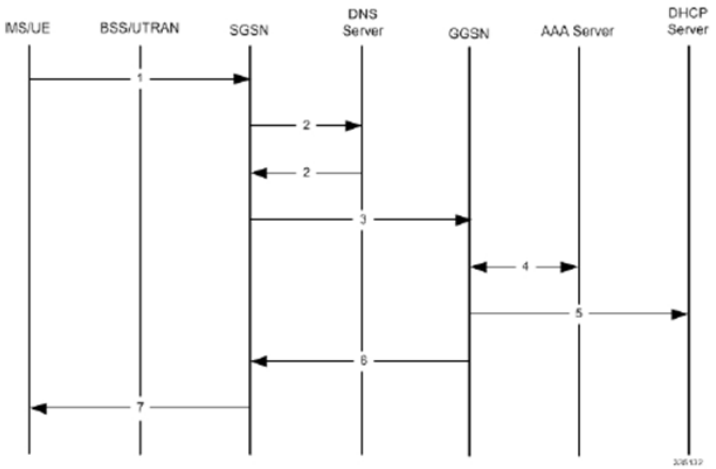
SGSNs and GGSNs work in conjunction within the GPRS/UMTS network. As indicated earlier in the section on *System Configuration Options*, the flexible architecture of StarOS enables a single chassis to reduce hardware requirements by supporting integrated co-location of a variety of the SGSN services.

Id. at 5.

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80

(Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

The SGSN sends the Create PDP Context Request message that contains an APN field. For example, in the PDP Activation procedure, "[t]he SGSN sends a Create PDP Context Request message to the GGSN. This message identifies the APN the UE is attempting to connect to and other information about the subscriber." WSOU-CISCO013800 at 102.

1. A PDP Activation Request message is sent from the UE to the SGSN by the BSS over the Gb interface. This request includes the Access Point Name (APN) the UE is attempting to connect to. This is typically a Frame relay connection.
2. The SGSN queries the DNS server to resolve the APN to the IP address of the GGSN to use to establish the PDP context.
3. The SGSN sends a Create PDP Context Request message to the GGSN. This message identifies the APN the UE is attempting to connect to and other information about the subscriber.
4. The GGSN performs its processes for establishing the PDP context. This may include subscriber authentication, service provisioning, etc. The GGSN eventually sends an affirmative create PDP context response to the SGSN containing the IP address assigned to the UE.
5. The SGSN sends an Activate PDP Context Accept message back to the UE. The subscriber can now begin sending/receiving data.
6. The SGSN begins generating S-CDR data that will be sent to the CG.

WSOU-CISCO013800 at 102.

Further, the APN field in the Create PDP Context Request contains information relating to a request for either a private network address or a public network address for the mobile station. The APN field indicates requesting either a private network address of a public network address. The GGSN has an APN restriction value for each APN, and each APN corresponds to either a public, or a private address, according to its associated APN restriction value. For example, see claims 15, 2[A].

Further, "[d]uring default bearer activation the Gn/S4-SGSN sends the current Maximum APN Restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (if it is the first activation for that UE or if the APN Restriction is disabled, Maximum APN restriction will be "0" in the Create PDP Context Request/Create Session Request). The GGSN/P-GW has an APN restriction value for each APN. If the Maximum

<table>
<tr><td></td><td>APN Restriction for the subscriber is received in the Create PDP Context Request/Create Session Request and APN Restriction value of the APN to which activation is being requested do not concur then the GGSN/P-GW rejects the activation by sending a Create PDP Context/Create Session Response failure message to the G/S4-SGSN with EGTP cause EGTP_CAUSE_INCOMPATIBLE_APN_REST_TYPE (0x68).” Id. at 184; see also, e.g., CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.</td></tr>
<tr><td>16[B] receive a Create PDP Context Response message from the GGSN containing information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message.</td><td>Cisco’s Mobile Multimedia Gateway Platform includes the apparatus according to claim 15, see supra 15[Pre.]-15[B], wherein the apparatus is configured to receive a Create PDP Context Response message from the GGSN containing information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message.

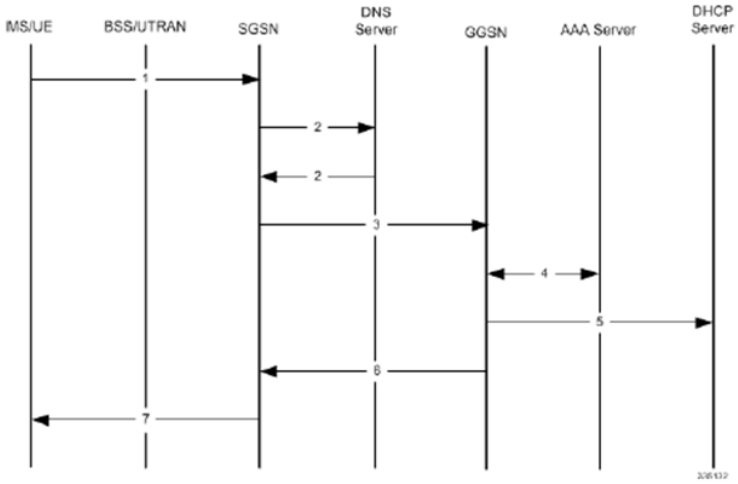
For example, as shown below in Step 6, once an IP address (public or private depending on the APN request) is chosen, the GGSN sends a Create PDP Context Response message to the SGSN containing the IP address assigned to the mobile station.

<table><tr><td>6</td><td>The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.</td></tr></table>
WSOU-CISCO013800 at 81.</td></tr>
</table>

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

See, e.g., WSOU-CISCO013800 at 80; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

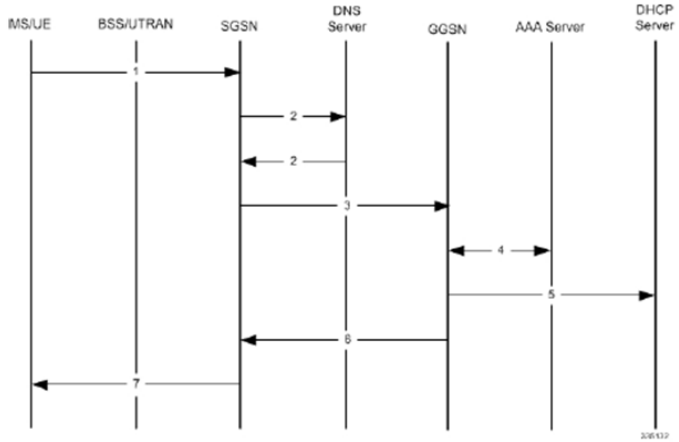
The IP address is resolved by the DNS server and checked by the GGSN, both according to information contained in the APN field of the Activate PDP Context Request message sent from the MS/UE (Mobile Station) to SGSN. The IP address can be either a private network address or a public network address. The GGSN/P-GW has an APN restriction value for each APN, and each APN corresponds to either a public, or a private address, according to its associated APN restriction value. For example, see claim 15.

CLAIM 17	
17[A] The apparatus according to claim 15, wherein the instructions, when executed, the apparatus is configured to: send a Create Packet Data Protocol (PDP) Context Request message to a Border Gateway (BG) of a network, the Create PDP Context Request message having an APN field containing information relating to a request for either a private network address or a public network address for the mobile station; and	Cisco's Mobile Multimedia Gateway Platform includes the apparatus according to claim 15, *see supra* 15[Pre.]-15[B], wherein the instructions, when executed, the apparatus is configured to: send a Create Packet Data Protocol (PDP) Context Request message to a Border Gateway (BG) of a network, the Create PDP Context Request message having an APN field containing information relating to a request for either a private network address or a public network address for the mobile station. For example, Cisco's Mobile Multimedia Gateway Platform includes both "Standalone gateway GPRS support node (GGSN)" and "Co-located P-GW/GGSN" deployments and interfaces. On information and belief, Cisco's Mobile Multimedia Gateway Platform sends a Create PDP Context Request message to a Gateway General Packet Radio System (GPRS) Support Node (GGSN) or to a Border Gateway (Packet Gateway: P-GW). *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 6-7 (Aug. 29, 2019)]. For example, "[d]uring default bearer activation, the SGSN sends the current maximum APN restriction value for the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send. If the maximum APN restriction of the UE (received in the CSR) and the APN Restriction value of the APN (for which activation is being requested) do not concur, then the GGSN/P-GW rejects activation. The maximum APN restriction for a UE is the most restrictive based on all already active default EPS bearers. The purpose of enabling APN Restriction in S4-SGSN is to determine whether the UE is allowed to establish EPS Bearers with other APNs based on the Maximum APN Restriction value associated with that UE." *Id.* at 183; *see also id.* at 23, 184. Therefore, the following figure and table specifying the PDP Context Activation Procedures workflow, that involves sending a Create PDP Context Request message, applies for both the Gateway General Packet Radio System (GPRS) Support Node (GGSN) or to a co-located GGSN/P-GW, as well as the same APN Restriction feature.

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

SGSN sends a Create PDP Context Request message to a Gateway General Packet Radio System (GPRS) Support Node (GGSN) of the network, the Create PDP Context Request message having an APN field containing information relating to a request for either a private network address or a public network address for the mobile station. For example, see 16[A].

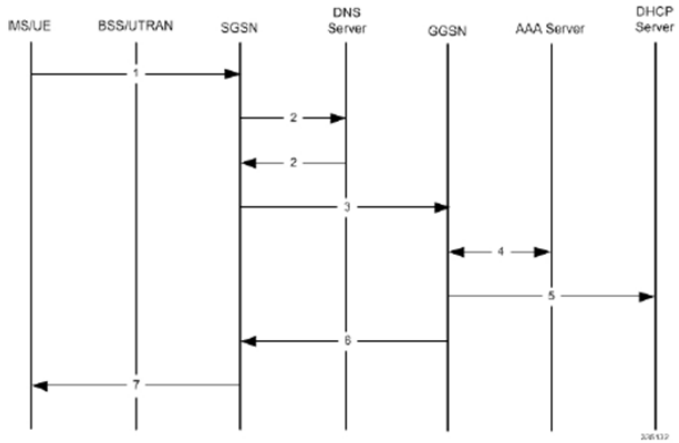
Given that the co-located GGSN/P-GW utilizes the same PDP Context Activation Procedures, in a workflow with co-located GGSN/P-GW , SGSN sends a Create PDP Context Request message to the P-GW, the Create PDP Context Request message having an APN field containing information relating to a request for either a private network address or a public network address for the mobile station.

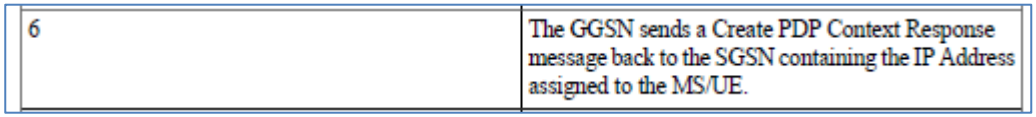
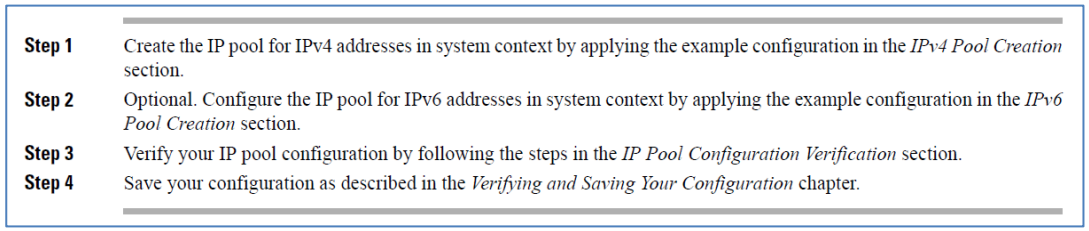
<table>
<tr><td></td><td>As shown in Step 3 below, to resolve the received APN in the PDP activation request message, the SGSN sends a Create PDP Context Request to the GGSN. In the same PDP Context Activation Procedures involving a co-located GGSN/P-GW, the SGSN sends a Create PDP Context Request to the P-GW, which works in conjunction with the SGSN to identify the APN the mobile station is attempting to connect to and other information about the subscriber. The SGSN sends an APN Restriction value (Maximum APN Restriction) in the Create PDP Context Request for establishing a PDP context.

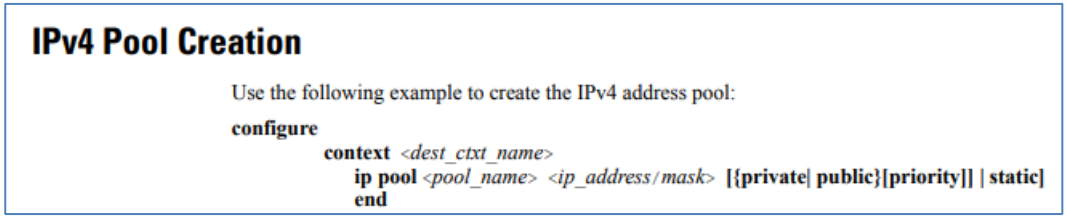
<table><tr><td>3</td><td>The SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context.</td></tr></table>
WSOU-CISCO013800 at 80.</td></tr>
<tr><td>17[B] receive a Create PDP Context Response message from the BG containing information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message.</td><td>Cisco’s Mobile Multimedia Gateway Platform includes the apparatus according to claim 15, see supra 15[Pre.]-15[B], wherein the apparatus is configured to receive a Create PDP Context Response message from the BG containing information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message.

For example, StarOS includes both “Standalone gateway GPRS support node (GGSN)” and “Co-located P-GW/GGSN” deployments and interfaces. On information and belief, Cisco’s Mobile Multimedia Gateway Platform is configured to receive a Create PDP Context Response message from a Gateway General Packet Radio System (GPRS) Support Node (GGSN) or a Border Gateway (Packet Gateway: P-GW). See WSOU-CISCO013800 [SGSN Administration Guide, StarOS Release 21.15, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 6-7 (Aug. 29, 2019)].

For example, “[d]uring default bearer activation, the SGSN sends the current maximum APN restriction value for the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send. If the maximum APN restriction of the UE (received in the CSR) and the APN Restriction value of the APN (for which activation is being requested) do not concur, then the GGSN/P-GW rejects activation. The maximum APN restriction for a UE is the most restrictive based on all already active default EPS bearers. The purpose of enabling APN Restriction in S4-SGSN is to determine whether the UE is allowed to establish</td></tr>
</table>

	EPS Bearers with other APNs based on the Maximum APN Restriction value associated with that UE." *Id.* at 183; *see also* 23, 184. Therefore, the following figure and table specifying the PDP Context Activation Procedures workflow, that involves sending a Create PDP Context Request message, applies for both the Gateway General Packet Radio System (GPRS) Support Node (GGSN) or to a co-located GGSN/P-GW, as well as the same APN Restriction feature. **PDP Context Activation Procedures** The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. ***Figure 9: Call Flow for PDP Context Activation***  The following table provides detailed explanations for each step indicated in the figure above. *See, e.g.*, WSOU-CISCO013800 at 80; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89. SGSN receives a Create PDP Context Response message from the GGSN containing information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message. For example, see 16[B]. Given that the co-located GGSN/P-GW utilizes the same PDP Context Activation Procedures, in a workflow with co-located GGSN/P-GW, SGSN receives a Create PDP Context Response message from P-GW containing information

	assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message. As shown in Step 6 below, once an IP address (public or private depending on the APN request) is chosen, the GGSN sends a Create PDP Context Response message to the SGSN containing the IP address assigned to the mobile station. In the same PDP Context Activation Procedures involving a co-located GGSN/P-GW, P-GW sends a Create PDP Context Response message to the SGSN containing the IP address assigned to the mobile station.  6 — The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE. WSOU-CISCO013800 at 81.
CLAIM 18	
18[A] The apparatus according to claim 15, wherein the private network address and the public network address are each one of an IPv4 network address and an IPv6 network address.	Cisco's Mobile Multimedia Gateway Platform includes the apparatus according to claim 15, *see supra* 15[Pre.]-15[B], wherein the private network address and the public network address are each one of an IPv4 network address and an IPv6 network address. For example, Cisco's Mobile Multimedia Gateway Platform practices a method of creating an IP pool for IPv4 addresses in system context and configuring the IP pool for IPv6 addresses in system context.  **Step 1** Create the IP pool for IPv4 addresses in system context by applying the example configuration in the *IPv4 Pool Creation* section. **Step 2** Optional. Configure the IP pool for IPv6 addresses in system context by applying the example configuration in the *IPv6 Pool Creation* section. **Step 3** Verify your IP pool configuration by following the steps in the *IP Pool Configuration Verification* section. **Step 4** Save your configuration as described in the *Verifying and Saving Your Configuration* chapter. *See* WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 105 (April 27, 2017)].

	To configure the IP pool:  **IPv4 Pool Creation** Use the following example to create the IPv4 address pool: **configure** **context** *<dest_ctxt_name>* **ip pool** *<pool_name> <ip_address/mask>* **[{private| public}[priority]] | static]** **end** *Id*. at 106.
CLAIM 19	
19[A] The apparatus according to claim 15, wherein the network is a GPRS communications network.	Cisco's Mobile Multimedia Gateway Platform includes the apparatus according to claim 15, *see supra* 15[Pre.]-15[B], wherein the network is a GPRS communications network. Cisco's Mobile Multimedia Gateway Platform includes a GPRS communications network. For example: "StarOS provides a highly flexible and efficient Serving GPRS Support Node (SGSN) service to the wireless carriers. Functioning as an SGSN, the system readily handles wireless data services within 2.5G General Packet Radio Service (GPRS) and 3G Universal Mobile Telecommunications System (UMTS) data networks. The SGSN also can serve as an interface between GPRS and/or UMTS networks and the 4G Evolved Packet Core (EPC) network." *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 5 (Aug. 29, 2019)].
CLAIM 20	
20[A] The apparatus according to claim 15, wherein the network is a Universal Mobile	Cisco's Mobile Multimedia Gateway Platform includes the apparatus according to claim 15, *see supra* 15[Pre.]-15[B], wherein the network is a Universal Mobile Telecommunications System. Cisco's Mobile Multimedia Gateway Platform includes a network that is a Universal Mobile Telecommunications system. For example: "StarOS provides a highly flexible and efficient Serving GPRS Support Node (SGSN) service to the wireless carriers. Functioning as an SGSN, the system readily handles wireless data services within 2.5G General Packet Radio Service (GPRS) and 3G Universal Mobile Telecommunications System (UMTS) data networks.

Telecommunications System.	The SGSN also can serve as an interface between GPRS and/or UMTS networks and the 4G Evolved Packet Core (EPC) network." *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 5 (Aug. 29, 2019)].
CLAIM 21	
21[A] The apparatus according to claim 15, wherein the information comprises one or more parameters that explicitly indicates requesting either a private network address or a public network address to be assigned to the mobile station.	Cisco's Mobile Multimedia Gateway Platform includes the apparatus according to claim 15, *see supra* 15[Pre.]-15[B], wherein the information comprises one or more parameters that explicitly indicates requesting either a private network address or a public network address to be assigned to the mobile station. For example, the APN Restriction value determines the type of application data the subscriber can send. The "APN Restriction value corresponding to each APN is known by the GGSN/P-GW. The Gn/S4-SGSN sends the Maximum APN Restriction of the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request. The GGSN/P-GW accepts or rejects the activation based on the Maximum APN Restriction of UE and APN Restriction value of that APN which is sent the Create PDP Context Request/Create Session Request." *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 5 (Aug. 29, 2019)]. Another parameter is the APN Restriction value, which determines the type of application data the subscriber can send. "During default bearer activation, the SGSN sends the current maximum APN restriction value for the UE to the GGSN/P-GW in a Create PDP Context Request/ Create Session Request (CSR)." The "APN Restriction value corresponding to each APN is known by the GGSN/P-GW. The Gn/S4-SGSN sends the Maximum APN Restriction of the UE to the GGSN/P-GW in a Create PDP Context Request/Create Session Request. The GGSN/P-GW accepts or rejects the activation based on the Maximum APN Restriction of UE and APN Restriction value of that APN which is sent the Create PDP Context Request/Create Session Request." *Id.* at 183; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.

The APN Restriction values explicitly indicate the request for a private or public network address to be assigned to the mobile station. For example, when the "APN Restriction Value allowed to be established" is "1," then the "Private" APN for Corporate is assigned in the exemplary manner shown below.

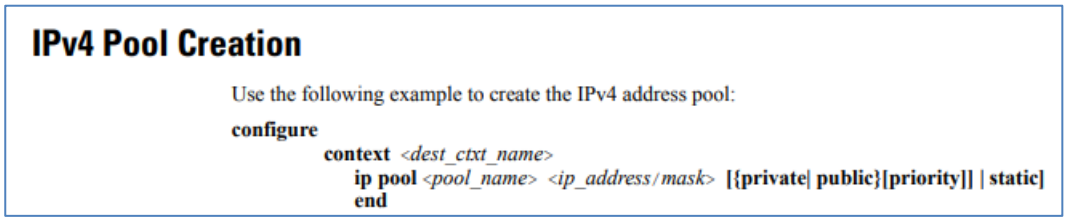
Table 13: APN restriction values

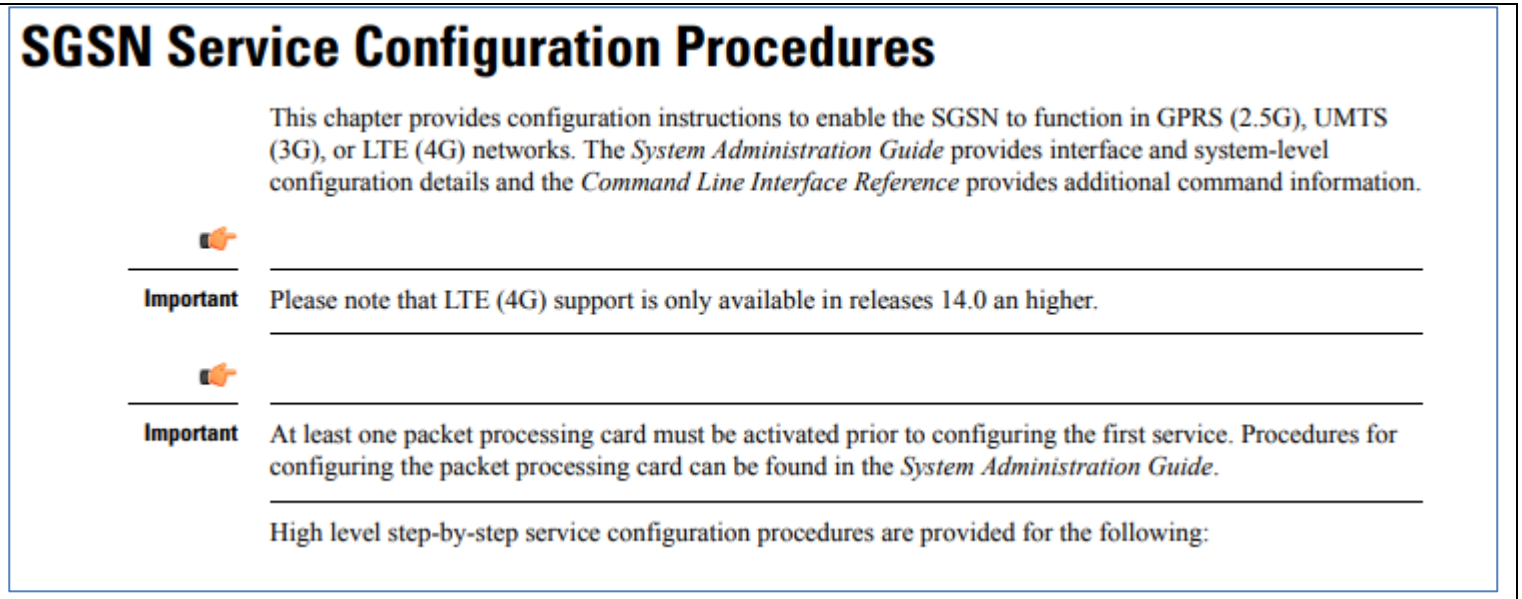
Maximum APN Restriction Value	Type of APN	Application Example	APN Restriction Value allowed to be established
0	No Existing Contexts or Restriction		All
1	Public-1	WAP or MMS	1, 2, 3
2	Public-2	Internet or PSPDN	1, 2
3	Private-1	Corporate (for example MMS subscribers)	1
4	Private-2	Corporate (for example non-MMS subscribers)	None

WSOU-CISCO013800 at 184.

"Before an MS is able to access data services, they must have an IP address. As described previously, the GGSN supports static or dynamic addressing (through locally configured address pools on the system, DHCP client-mode, or DHCP relay-mode). Regardless of the allocation method, a corresponding address pool must be configured." *See* WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 104 (April 27, 2017)]. To configure the IP pool:

Step 1	Create the IP pool for IPv4 addresses in system context by applying the example configuration in the *IPv4 Pool Creation* section.
Step 2	Optional. Configure the IP pool for IPv6 addresses in system context by applying the example configuration in the *IPv6 Pool Creation* section.
Step 3	Verify your IP pool configuration by following the steps in the *IP Pool Configuration Verification* section.
Step 4	Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.

	Id. at 105.  **IPv4 Pool Creation** Use the following example to create the IPv4 address pool: **configure** **context** *<dest_ctxt_name>* **ip pool** *<pool_name> <ip_address/mask>* **[{private| public}[priority]] | static]** **end** *Id*. at 106.
CLAIM 22	
22[Pre.] An apparatus comprising a processor and a memory storing instructions that, when executed, the apparatus is configured to:	To any extent the preamble is limiting, Cisco's Mobile Multimedia Gateway Platform includes an apparatus comprising a processor and a memory storing instructions that, when executed, the apparatus is configured to perform the functions described below.



SGSN Service Configuration Procedures

This chapter provides configuration instructions to enable the SGSN to function in GPRS (2.5G), UMTS (3G), or LTE (4G) networks. The *System Administration Guide* provides interface and system-level configuration details and the *Command Line Interface Reference* provides additional command information.

Important Please note that LTE (4G) support is only available in releases 14.0 an higher.

Important At least one packet processing card must be activated prior to configuring the first service. Procedures for configuring the packet processing card can be found in the *System Administration Guide*.

High level step-by-step service configuration procedures are provided for the following:

See WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 118 (Aug. 29, 2019)].

For example, "[t]he SGSN is designed to accommodate a very high rate of simultaneous attaches. The actual attach rate depends on the latencies introduced by the network and scaling of peers. In order to optimize the entire signaling chain, the SGSN eliminates or minimizes bottlenecks caused by large scale control signaling. For this purpose, the SGSN implements features such as an in-memory data-VLR and SuperCharger. Both IMSI and P-TMSI based attaches are supported." *Id.* at 15.

Further, "[t]he SGSN authenticates the subscriber via the authentication procedure. This procedure is invoked on attaches, PDP activations, inter-SGSN routing Area Updates (RAUs), and optionally by configuration for periodic RAUs. The procedure requires the SGSN to retrieve authentication quintets/triplets from the HLR (AuC) and issuing an authentication and ciphering request to the MN. The SGSN implements an in-memory data-VLR functionality to pre-fetch and store authentication vectors from the HLR. This decreases latency of the control procedures." *Id.* at 16.

<table>
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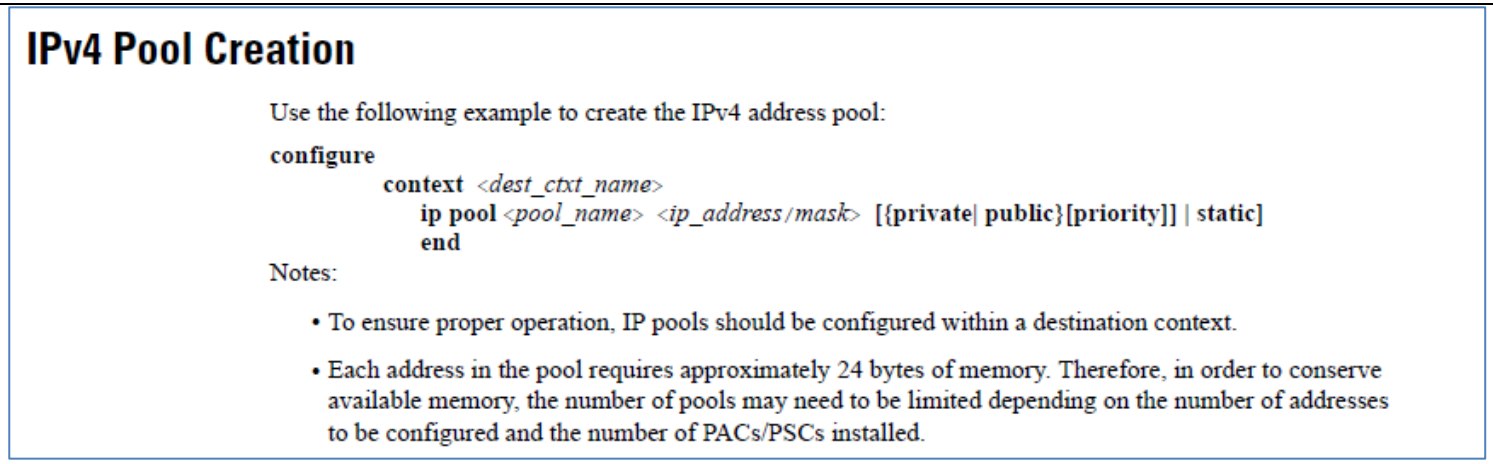


IPv4 Pool Creation

Use the following example to create the IPv4 address pool:

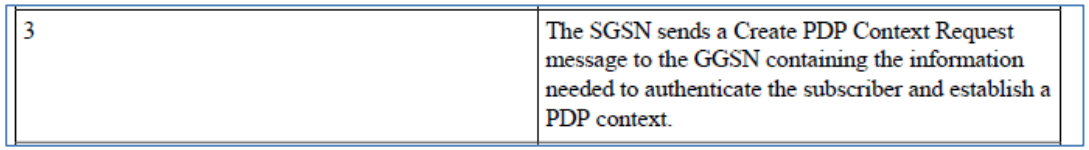
configure
context *<dest_ctxt_name>*
ip pool *<pool_name>* *<ip_address/mask>* **[{private| public}[priority]] | static]**
end

Notes:

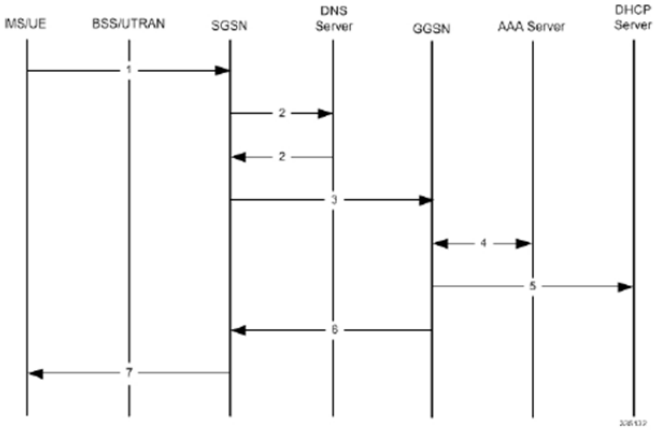
- To ensure proper operation, IP pools should be configured within a destination context.
- Each address in the pool requires approximately 24 bytes of memory. Therefore, in order to conserve available memory, the number of pools may need to be limited depending on the number of addresses to be configured and the number of PACs/PSCs installed.

See WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 106 (April 27, 2017)].</td></tr>
<tr><td>**22[A]** receive a Create Packet Data Protocol (PDP) Context Request message from a Serving General Packet Radio System (GPRS) Support Node (SGSN), the Create PDP Context Request Message having an APN (Access Point Name) field containing</td><td>Cisco's Mobile Multimedia Gateway Platform includes an apparatus comprising a processor and a memory storing instructions that is configured to receive a Create Packet Data Protocol (PDP) Context Request message from a Serving General Packet Radio System (GPRS) Support Node (SGSN), the Create PDP Context Request Message having an APN (Access Point Name) field containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to a mobile station of a network.

For example, as shown in Step 3 below, the SGSN sends a Create PDP Context Request to the GGSN, which works in conjunction with the SGSN to identify the APN the mobile station is attempting to connect to and other information about the subscriber. The SGSN sends an APN Restriction value (Maximum APN Restriction) in the Create PDP Context Request for establishing a PDP context.



3	The SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context.
</td></tr>
</table>

information that explicitly indicates requesting either a private network address or a public network address to be assigned to a mobile station of a network;	*See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]. **SGSN and Dual Access SGSN Deployments** SGSNs and GGSNs work in conjunction within the GPRS/UMTS network. As indicated earlier in the section on *System Configuration Options*, the flexible architecture of StarOS enables a single chassis to reduce hardware requirements by supporting integrated co-location of a variety of the SGSN services. *Id*. at 5. **PDP Context Activation Procedures** The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. ***Figure 9: Call Flow for PDP Context Activation***  The following table provides detailed explanations for each step indicated in the figure above. ***Table 3: PDP Context Activation Procedure*** **Step** | **Description** 1 | The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

See, e.g., id. at 80; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

The SGSN sends the Create PDP Context Request message that contains an APN field. For example, in the PDP Activation procedure, "[t]he SGSN sends a Create PDP Context Request message to the GGSN. This message identifies the APN the UE is attempting to connect to and other information about the subscriber." WSOU-CISCO013800 at 102.

1. A PDP Activation Request message is sent from the UE to the SGSN by the BSS over the Gb interface. This request includes the Access Point Name (APN) the UE is attempting to connect to. This is typically a Frame relay connection.
2. The SGSN queries the DNS server to resolve the APN to the IP address of the GGSN to use to establish the PDP context.
3. The SGSN sends a Create PDP Context Request message to the GGSN. This message identifies the APN the UE is attempting to connect to and other information about the subscriber.
4. The GGSN performs its processes for establishing the PDP context. This may include subscriber authentication, service provisioning, etc. The GGSN eventually sends an affirmative create PDP context response to the SGSN containing the IP address assigned to the UE.
5. The SGSN sends an Activate PDP Context Accept message back to the UE. The subscriber can now begin sending/receiving data.
6. The SGSN begins generating S-CDR data that will be sent to the CG.

Id. at 102.

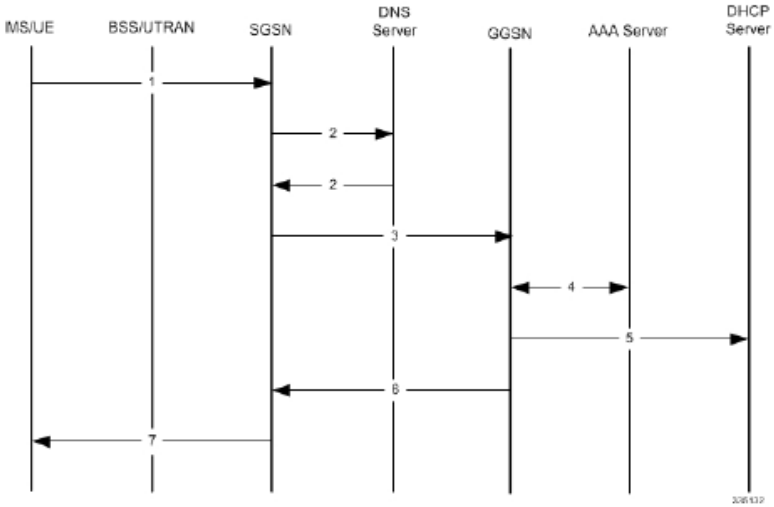
The APN field in the Create PDP Context Request contains information relating to a request for either a private network address or a public network address for the mobile station. The APN field indicates requesting either a private network address of a public network address. The GGSN/P-GW has an APN restriction value for each APN, and each APN corresponds to either a public, or a private address, Similar to its associated APN restriction value. For example, see claims 15, 2[A].

Further, "[d]uring default bearer activation the Gn/S4-SGSN sends the current Maximum APN Restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (if it is the first activation for that UE or if the APN Restriction is disabled, Maximum APN restriction will be "0" in the Create PDP Context Request/Create Session Request). The GGSN/P-GW has an APN restriction value for each APN. If the Maximum

	APN Restriction for the subscriber is received in the Create PDP Context Request/Create Session Request and APN Restriction value of the APN to which activation is being requested do not concur then the GGSN/P-GW rejects the activation by sending a Create PDP Context/Create Session Response failure message to the G/S4-SGSN with EGTP cause EGTP_CAUSE_INCOMPATIBLE_APN_REST_TYPE (0x68)." WSOU-CISCO013800 at 184; *see also*, *e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.
22[B] assign either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message; and	Cisco's Mobile Multimedia Gateway Platform includes an apparatus comprising a processor and a memory storing instructions that is configured to assign either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message. The Create PDP Context Request contains an APN field containing information relating to a request for either a private network address or a public network address for the mobile station. For example, see 22[A]. As shown below, the mobile station is assigned an IP address (public or private) based on the information contained in the APN field of the Create PDP Context Request message. The GGSN checks whether the APN Restriction value received in the Create PDP Context Request from the SGSN and the APN Restriction value of the APN to which access is requested are the same. For example, "[d]uring default bearer activation the Gn/S4-SGSN sends the current Maximum APN Restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (if it is the first activation for that UE or if the APN Restriction is disabled, Maximum APN restriction will be "0" in the Create PDP Context Request/Create Session Request). The GGSN/P-GW has an APN restriction value for each APN. If the Maximum APN Restriction for the subscriber is received in the Create PDP Context Request/Create Session Request and APN Restriction value of the APN to which activation is being requested do not concur then the GGSN/P-GW rejects the activation by sending a Create PDP Context/Create Session Response failure message to the G/S4-SGSN with EGTP cause EGTP_CAUSE_INCOMPATIBLE_APN_REST_TYPE (0x68)." WSOU-CISCO013800 at 184. If the values are the same, the GGSN creates the PDP context and sends a create response message back to the SGSN containing the IP address assigned to the UE/MS in Step 6. The SGSN then sends an Activate PDP Context Accept message to the UE/MS in Step 7 along with the public or private IP address from GGSN.

Step	Description
5	If the MS/UE requires an IP address, the GGSN may allocate one dynamically via DHCP.
6	The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.
7	The SGSN sends a Activate PDP Context Accept message to the MS/UE along with the IP Address. Upon PDP Context Activation, the SGSN begins generating S-CDRs. The S-CDRs are updated periodically based on Charging Characteristics and trigger conditions. A GTP-U tunnel is now established and the MS/UE can send and receive data.

See WSOU-CISCO013800 at 81.

	PDP Context Activation Procedures The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. ***Figure 9: Call Flow for PDP Context Activation***  *See, e.g.*, WSOU-CISCO013800 at 80; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.
22[C] send the Create PDP Context Response message to the SGSN containing the information assigning either a private network address or a public network address to	Cisco's Mobile Multimedia Gateway Platform includes an apparatus comprising a processor and a memory storing instructions that is configured to send the Create PDP Context Response message to the SGSN containing the information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message. For example, as shown below in Step 6, the GGSN sends a Create PDP Context Response message to the SGSN containing the IP address (public or private depending on the APN request) assigned to the mobile station.

the mobile station based on the information contained in the APN field of the Create PDP Context Request message.	

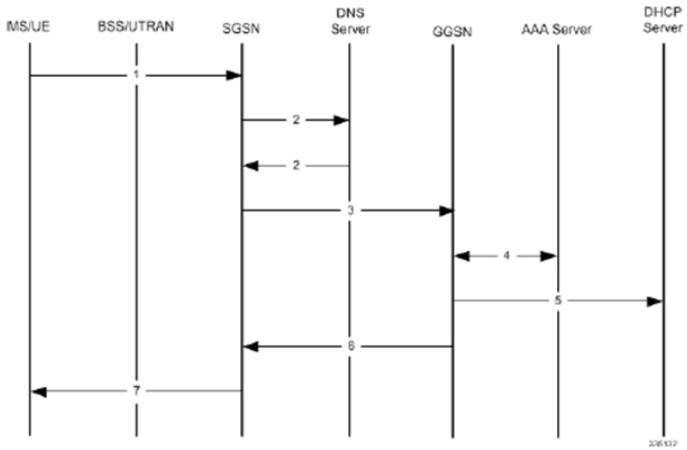
6	The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.

See WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

See, e.g., WSOU-CISCO013800 at 80; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

	As discussed above, the IP address sent in the Create PDP Context Response message from the GGSN to the SGSN is based on the information contained in the APN field of the Create PDP Context Request message. The IP address can be either a public address or a private address. For example, see claim 15.
CLAIM 23	
23[Pre.] An apparatus comprising a processor and a memory storing instructions that, when executed, the apparatus is configured to:	To any extent the preamble is limiting, Cisco's Mobile Multimedia Gateway Platform includes an apparatus comprising a processor and a memory storing instructions that, when executed, the apparatus is configured to perform the functions described below. **SGSN Service Configuration Procedures** This chapter provides configuration instructions to enable the SGSN to function in GPRS (2.5G), UMTS (3G), or LTE (4G) networks. The *System Administration Guide* provides interface and system-level configuration details and the *Command Line Interface Reference* provides additional command information. **Important** Please note that LTE (4G) support is only available in releases 14.0 an higher. **Important** At least one packet processing card must be activated prior to configuring the first service. Procedures for configuring the packet processing card can be found in the *System Administration Guide*. High level step-by-step service configuration procedures are provided for the following: *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 118 (Aug. 29, 2019)]. For example, "[t]he SGSN is designed to accommodate a very high rate of simultaneous attaches. The actual attach rate depends on the latencies introduced by the network and scaling of peers. In order to optimize the entire signaling

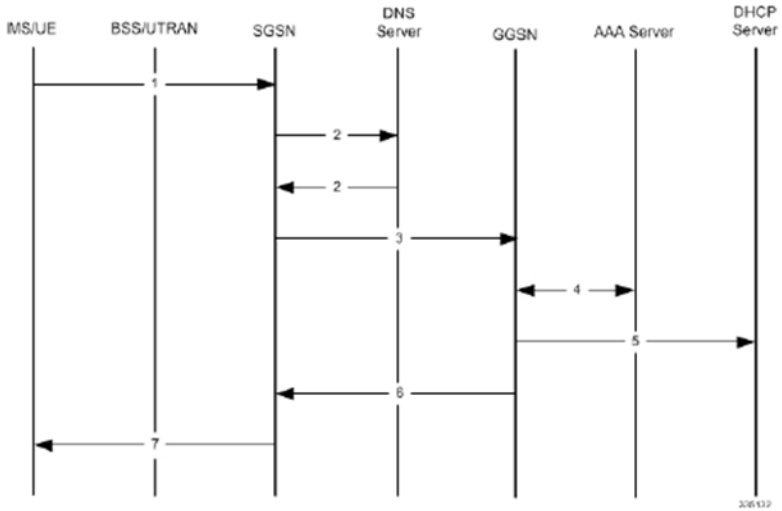
	chain, the SGSN eliminates or minimizes bottlenecks caused by large scale control signaling. For this purpose, the SGSN implements features such as an in-memory data-VLR and SuperCharger. Both IMSI and P-TMSI based attaches are supported." *Id.* at 15. Further, "[t]he SGSN authenticates the subscriber via the authentication procedure. This procedure is invoked on attaches, PDP activations, inter-SGSN routing Area Updates (RAUs), and optionally by configuration for periodic RAUs. The procedure requires the SGSN to retrieve authentication quintets/triplets from the HLR (AuC) and issuing an authentication and ciphering request to the MN. The SGSN implements an in-memory data-VLR functionality to pre-fetch and store authentication vectors from the HLR. This decreases latency of the control procedures." *Id.* at 16. **IPv4 Pool Creation** Use the following example to create the IPv4 address pool: **configure** **context** <*dest_ctxt_name*> **ip pool** <*pool_name*> <*ip_address/mask*> **[{private| public}[priority]] | static]** **end** Notes: • To ensure proper operation, IP pools should be configured within a destination context. • Each address in the pool requires approximately 24 bytes of memory. Therefore, in order to conserve available memory, the number of pools may need to be limited depending on the number of addresses to be configured and the number of PACs/PSCs installed. *See* WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 106 (April 27, 2017)].
23[A] receive a Create PDP Context Request message from a Serving General Packet Radio System	Cisco's Mobile Multimedia Gateway Platform includes an apparatus comprising a processor and a memory storing instructions that is configured to receive a Create PDP Context Request message from a Serving General Packet Radio System (GPRS) Support Node (SGSN) of a network, the Create PDP Context Request message having an APN (Access Point Name)field containing one or more parameters that explicitly indicates requesting either a private network address or a public network address to be assigned to a mobile station of the network.

(GPRS) Support Node (SGSN) of a network, the Create PDP Context Request message having an APN (Access Point Name) field containing one or more parameters that explicitly indicates requesting either a private network address or a public network address to be assigned to a mobile station of the network;	For example, as shown in Step 3 below, the SGSN sends a Create PDP Context Request to the GGSN, which works in conjunction with the SGSN to identify the APN the mobile station is attempting to connect to and other information about the subscriber. The SGSN sends an APN Restriction value (Maximum APN Restriction) in the Create PDP Context Request for establishing a PDP context. 3 — The SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context. *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]. **SGSN and Dual Access SGSN Deployments** SGSNs and GGSNs work in conjunction within the GPRS/UMTS network. As indicated earlier in the section on *System Configuration Options*, the flexible architecture of StarOS enables a single chassis to reduce hardware requirements by supporting integrated co-location of a variety of the SGSN services. *Id*. at 5.

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

The SGSN sends the APN Restriction value for the UE to the GGSN in the Create PDP Context Request. In the PDP Activation procedure, "[t]he SGSN sends a Create PDP Context Request message to the GGSN. This message

identifies the APN the UE is attempting to connect to and other information about the subscriber." WSOU-CISCO013800 at 102.

1. A PDP Activation Request message is sent from the UE to the SGSN by the BSS over the Gb interface. This request includes the Access Point Name (APN) the UE is attempting to connect to. This is typically a Frame relay connection.
2. The SGSN queries the DNS server to resolve the APN to the IP address of the GGSN to use to establish the PDP context.
3. The SGSN sends a Create PDP Context Request message to the GGSN. This message identifies the APN the UE is attempting to connect to and other information about the subscriber.
4. The GGSN performs its processes for establishing the PDP context. This may include subscriber authentication, service provisioning, etc. The GGSN eventually sends an affirmative create PDP context response to the SGSN containing the IP address assigned to the UE.
5. The SGSN sends an Activate PDP Context Accept message back to the UE. The subscriber can now begin sending/receiving data.
6. The SGSN begins generating S-CDR data that will be sent to the CG.

Id. at 102.

The APN field in the Create PDP Context Request contains information relating to a request for either a private network address or a public network address for the mobile station. The APN field indicates requesting either a private network address of a public network address. The GGSN/P-GW has an APN restriction value for each APN, and each APN corresponds to either a public, or a private address, similar to its associated APN restriction value. For example, see claims 22[A], 2[A].

Further, "[d]uring default bearer activation the Gn/S4-SGSN sends the current Maximum APN Restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (if it is the first activation for that UE or if the APN Restriction is disabled, Maximum APN restriction will be "0" in the Create PDP Context Request/Create Session Request). The GGSN/P-GW has an APN restriction value for each APN. If the Maximum APN Restriction for the subscriber is received in the Create PDP Context Request/Create Session Request and APN Restriction value of the APN to which activation is being requested do not concur then the GGSN/P-GW rejects the activation by sending a Create PDP Context/Create Session Response failure message to the G/S4-SGSN with EGTP cause EGTP_CAUSE_INCOMPATIBLE_APN_REST_TYPE (0x68)." WSOU-CISCO013800 at 184; *see also, e.g.*,

	CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.
23[B] assign either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message; and	Cisco's Mobile Multimedia Gateway Platform includes an apparatus comprising a processor and a memory storing instructions that is configured to assign either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message. The Create PDP Context Request contains an APN field containing information relating to a request for either a private network address or a public network address for the mobile station. For example, see 23[A]. As shown below, the mobile station is assigned an IP address (public or private) based on the information contained in the APN field of the Create PDP Context Request message. The GGSN already has an APN Restriction value for each APN request by UE/MS. The GGSN checks whether the APN Restriction value received in the Create PDP Context Request from the SGSN and the APN Restriction value of the APN to which access is requested are the same. For example, see claim 22. Further, "[d]uring default bearer activation the Gn/S4-SGSN sends the current Maximum APN Restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (if it is the first activation for that UE or if the APN Restriction is disabled, Maximum APN restriction will be "0" in the Create PDP Context Request/Create Session Request). The GGSN/P-GW has an APN restriction value for each APN. If the Maximum APN Restriction for the subscriber is received in the Create PDP Context Request/Create Session Request and APN Restriction value of the APN to which activation is being requested do not concur then the GGSN/P-GW rejects the activation by sending a Create PDP Context/Create Session Response failure message to the G/S4-SGSN with EGTP cause EGTP_CAUSE_INCOMPATIBLE_APN_REST_TYPE (0x68)." WSOU-CISCO013800 at 184. If the values are the same, the GGSN creates the PDP context and sends a create response message back to the SGSN containing the IP address assigned to the UE/MS in Step 6. The SGSN then sends an Activate PDP Context Accept message to the UE/MS in Step 7 along with the public or private IP address from GGSN.

Step	Description
5	If the MS/UE requires an IP address, the GGSN may allocate one dynamically via DHCP.
6	The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.
7	The SGSN sends a Activate PDP Context Accept message to the MS/UE along with the IP Address. Upon PDP Context Activation, the SGSN begins generating S-CDRs. The S-CDRs are updated periodically based on Charging Characteristics and trigger conditions. A GTP-U tunnel is now established and the MS/UE can send and receive data.

See WSOU-CISCO013800 at 81.

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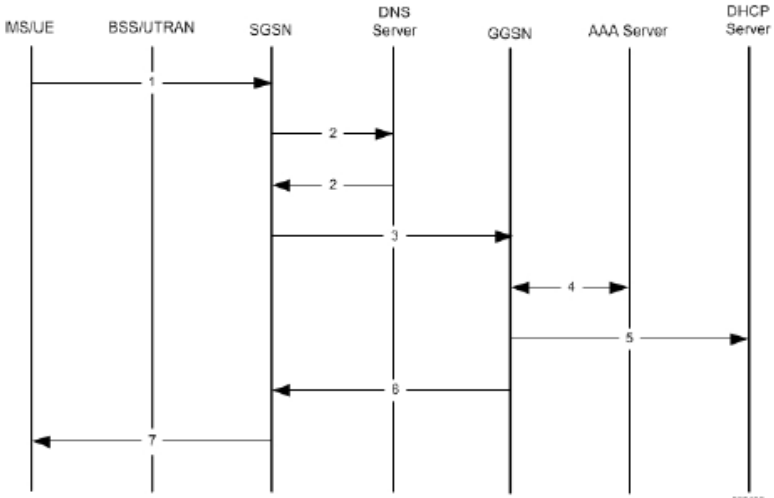
PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.</td></tr>
<tr><td>**23[C]** send the Create PDP Context Response message to the SGSN containing the information assigning either a private network</td><td>Cisco's Mobile Multimedia Gateway Platform includes an apparatus comprising a processor and a memory storing instructions that is configured to send the Create PDP Context Response message to the SGSN containing the information assigning either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message.

For example, as shown below in Step 6, the GGSN sends a Create PDP Context Response message to the SGSN containing the IP address (public or private depending on the APN request) assigned to the mobile station.</td></tr>
</table>

address or a public network address to the mobile station based on the information contained in the APN field of the Create PDP Context Request message.

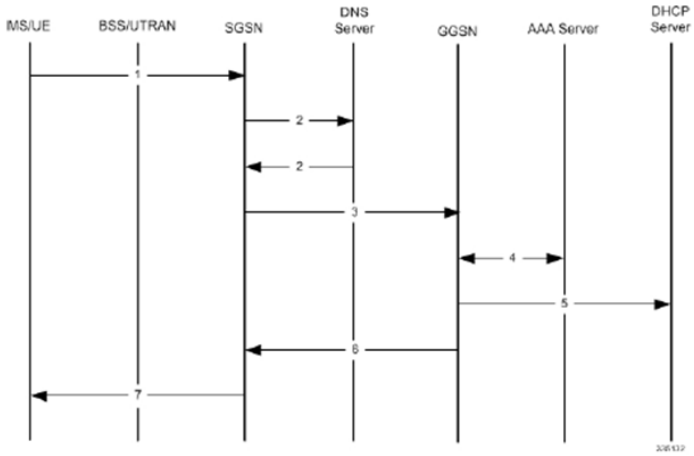
6	The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE.

See WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



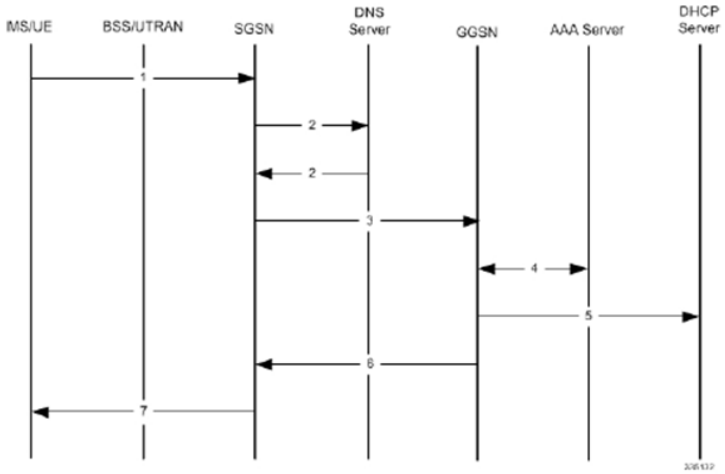
The following table provides detailed explanations for each step indicated in the figure above.

Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

	See, e.g., id. at 80; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89. The IP address sent in the Create PDP Context Response message from the GGSN to the SGSN is based on the information contained in the APN field of the Create PDP Context Request message. The IP address can be either a public address or a private address. For example, see claim 22.
CLAIM 24	
24[Pre.] An apparatus comprising a processor and a memory storing instructions that, when executed, the apparatus is configured to:	Cisco's Mobile Multimedia Gateway Platform includes an apparatus comprising a processor and a memory storing instructions that, when executed, the apparatus is configured to perform the functions described below. **SGSN Service Configuration Procedures** This chapter provides configuration instructions to enable the SGSN to function in GPRS (2.5G), UMTS (3G), or LTE (4G) networks. The *System Administration Guide* provides interface and system-level configuration details and the *Command Line Interface Reference* provides additional command information. **Important** Please note that LTE (4G) support is only available in releases 14.0 an higher. **Important** At least one packet processing card must be activated prior to configuring the first service. Procedures for configuring the packet processing card can be found in the *System Administration Guide*. High level step-by-step service configuration procedures are provided for the following: *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 118 (Aug. 29, 2019)].

	For example, "[t]he SGSN is designed to accommodate a very high rate of simultaneous attaches. The actual attach rate depends on the latencies introduced by the network and scaling of peers. In order to optimize the entire signaling chain, the SGSN eliminates or minimizes bottlenecks caused by large scale control signaling. For this purpose, the SGSN implements features such as an in-memory data-VLR and SuperCharger. Both IMSI and P-TMSI based attaches are supported." *Id.* at 15. Further, "[t]he SGSN authenticates the subscriber via the authentication procedure. This procedure is invoked on attaches, PDP activations, inter-SGSN routing Area Updates (RAUs), and optionally by configuration for periodic RAUs. The procedure requires the SGSN to retrieve authentication quintets/triplets from the HLR (AuC) and issuing an authentication and ciphering request to the MN. The SGSN implements an in-memory data-VLR functionality to pre-fetch and store authentication vectors from the HLR. This decreases latency of the control procedures." *Id.* at 16. **IPv4 Pool Creation** Use the following example to create the IPv4 address pool: **configure** **context** <*dest_ctxt_name*> **ip pool** <*pool_name*> <*ip_address/mask*> **[{private| public}[priority]] | static]** **end** Notes: • To ensure proper operation, IP pools should be configured within a destination context. • Each address in the pool requires approximately 24 bytes of memory. Therefore, in order to conserve available memory, the number of pools may need to be limited depending on the number of addresses to be configured and the number of PACs/PSCs installed. *See* WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 106 (April 27, 2017)].
24[A] send an Activate Packet Data Protocol (PDP) Context Request	Cisco's Mobile Multimedia Gateway Platform includes an apparatus comprising a processor and a memory storing instructions that is configured to send an Activate Packet Data Protocol (PDP) Context Request message to a Serving General Packet Radio System (GPRS) Support Node (SGSN) of a network, the Activate PDP Context Request

message to a Serving General Packet Radio System (GPRS) Support Node (SGSN) of a network, the Activate PDP Context Request message having an APN (Access Point Name) field containing information containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to the mobile station; and	message having an APN (Access Point Name) field containing information containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to the mobile station. For example, as shown below in Step 1, a mobile station (MS, or UE "User Equipment") sends a PDP Activation Request message containing an APN field to SGSN. **PDP Context Activation Procedures** The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection. ***Figure 9: Call Flow for PDP Context Activation***  The following table provides detailed explanations for each step indicated in the figure above. ***Table 3: PDP Context Activation Procedure*** **Step** | **Description** 1 | The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN). *See, e.g.*, WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

The APN indicates requesting either a private network address of a public network address. The GGSN/P-GW has an APN restriction value for each APN. The APN Restriction values explicitly indicate the request for a private or public network address to be assigned to the mobile station. For example, when the "APN Restriction Value allowed to be established" is "1" then the "Private" APN for Corporate is assigned in the exemplary manner shown below.

Table 13: APN restriction values

Maximum APN Restriction Value	Type of APN	Application Example	APN Restriction Value allowed to be established
0	No Existing Contexts or Restriction		All
1	Public-1	WAP or MMS	1, 2, 3
2	Public-2	Internet or PSPDN	1, 2
3	Private-1	Corporate (for example MMS subscribers)	1
4	Private-2	Corporate (for example non-MMS subscribers)	None

See WSOU-CISCO013800 at 184.

"During default bearer activation, the SGSN sends the current Maximum APN restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send." This indicates that each APN corresponds to either a public, or a private address, according to its associated APN restriction value. For example, the "APN Restriction value corresponding to each APN is known by the GGSN/P-GW. The Gn/S4-SGSN sends the Maximum APN Restriction of the UE ["User Equipment"] to the GGSN/P-GW in a Create PDP Context Request/Create Session Request. The GGSN/P-GW accepts or rejects the activation based on the Maximum APN Restriction of UE and APN Restriction value of that APN which is sent the Create PDP Context Request/Create Session Request... This feature provides the operator with increased control to restrict certain APNs to UEs based on the type of APN." *Id.* at 183-184; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.

Therefore, an Activate PDP Context Request message is sent to SGSN from a mobile station of the network, the Activate PDP Context Request message having an APN field containing information containing information that explicitly indicates requesting either a private network address or a public network address to be assigned to the mobile station. After the SGSN receives the Activate PDP Context Request message in Step 1, the SGSN sends a DNS query to resolve the APN provided by the Mobile Station to a GGSN address in Step 2. The DNS server provides a response containing the private or public IP address of a GGSN to the SGSN.

2	The SGSN sends a DNS query to resolve the APN provided by the MS/UE to a GGSN address. The DNS server provides a response containing the IP address of a GGSN.

WSOU-CISCO013800 at 80. The below shows configurations of IPv4 and IPv6 DNS.

Configuring IPv4 DNS

Use the following example to configure the IPv4 DNS support in IPv4v6 PDP context:

```
configure
        context <src_ctxt_name>
            apn <apn_name>
                dns primary <ipv4_address>
                dns secondary <ipv4_address>
                end
```

Notes:

- <*ipv4_address*> is the IP address of the domain name server configured as DNS list in context configuration mode.

Configuring IPv6 DNS

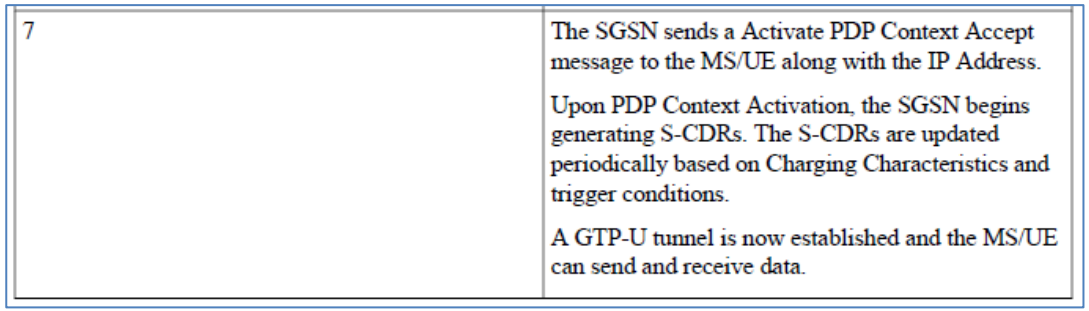
Use the following example to configure the IPv6 DNS support in IPv4v6 PDP context:

```
configure
        context <src_ctxt_name>
            apn <apn_name>
                ipv6 dns primary <ipv6_address>
                ipv6 dns secondary <ipv6_address>
                end
```

Notes:

- <*ipv6_address*> is the IP address of the domain name server configured as DNS list in context configuration mode.

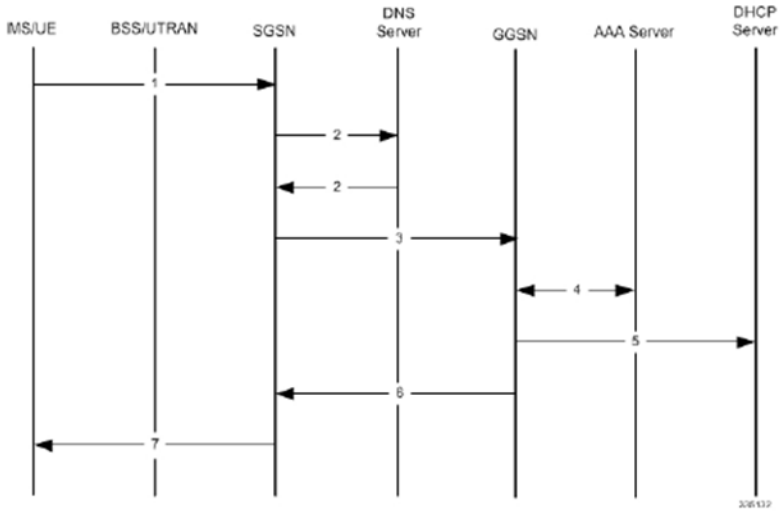
	See WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 104]. "Before an MS is able to access data services, they must have an IP address. As described previously, the GGSN supports static or dynamic addressing (through locally configured address pools on the system, DHCP client-mode, or DHCP relay-mode). Regardless of the allocation method, a corresponding address pool must be configured." *Id.* To configure the IP pool: **Step 1** Create the IP pool for IPv4 addresses in system context by applying the example configuration in the *IPv4 Pool Creation* section. **Step 2** Optional. Configure the IP pool for IPv6 addresses in system context by applying the example configuration in the *IPv6 Pool Creation* section. **Step 3** Verify your IP pool configuration by following the steps in the *IP Pool Configuration Verification* section. **Step 4** Save your configuration as described in the *Verifying and Saving Your Configuration* chapter. *Id.* at 105. **IPv4 Pool Creation** Use the following example to create the IPv4 address pool: **configure** **context** *<dest_ctxt_name>* **ip pool** *<pool_name> <ip_address/mask>* **[{private| public}[priority]] | static]** **end** *Id.* at 106.
24[B] receive an Activate PDP Context Accept message containing information relating to an assignment of either a private	Cisco's Mobile Multimedia Gateway Platform includes an apparatus comprising a processor and a memory storing instructions that is configured to receive an Activate PDP Context Accept message containing information relating to an assignment of either a private network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message. For example, as shown below in Step 7, the SGSN sends the Activate PDP Context Accept message to the mobile station (MS) along with the IP Address.

network address or a public network address to the mobile station based on the information contained in the APN field of the Activate PDP Context Request message.	 7 The SGSN sends a Activate PDP Context Accept message to the MS/UE along with the IP Address. Upon PDP Context Activation, the SGSN begins generating S-CDRs. The S-CDRs are updated periodically based on Charging Characteristics and trigger conditions. A GTP-U tunnel is now established and the MS/UE can send and receive data. *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

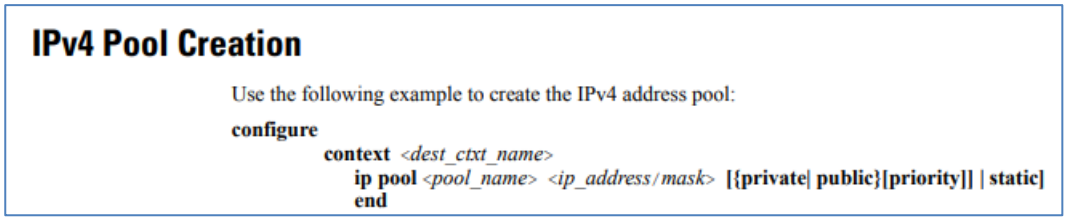
Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

The DNS server provides a response to SGSN containing the private or public IP address of a GGSN to the SGSN in Step 2. For example, see also 24[A]. The GGSN has an APN Restriction value for each APN request by UE/MS. The GGSN checks whether the APN Restriction value received in the Create PDP Context Request from the SGSN and

	the APN Restriction value of the APN to which access is requested are the same. If the values are the same, the GGSN creates the PDP context and sends a create response message back to the SGSN containing the IP address assigned to the UE/MS in Step 6. The SGSN then sends an Activate PDP Context Accept message to the UE/MS in Step 7 along with the public or private IP address from GGSN. For example, "[d]uring default bearer activation the Gn/S4-SGSN sends the current Maximum APN Restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (if it is the first activation for that UE or if the APN Restriction is disabled, Maximum APN restriction will be "0" in the Create PDP Context Request/Create Session Request). The GGSN/P-GW has an APN restriction value for each APN. If the Maximum APN Restriction for the subscriber is received in the Create PDP Context Request/Create Session Request and APN Restriction value of the APN to which activation is being requested do not concur then the GGSN/P-GW rejects the activation by sending a Create PDP Context/Create Session Response failure message to the G/S4-SGSN with EGTP cause EGTP_CAUSE_INCOMPATIBLE_APN_REST_TYPE (0x68)." WSOU-CISCO013800 at 184.
CLAIM 25	
25[A] The apparatus according to claim 24, wherein the private network address and the public network address are each one of an IPv4 network address and an IPv6 network address.	Cisco's Mobile Multimedia Gateway Platform includes the apparatus according to claim 24, *see supra* 24[Pre.]-24[B], wherein the private network address and the public network address are each one of an IPv4 network address and an IPv6 network address. For example, Cisco's Mobile Multimedia Gateway Platform practices a method of creating an IP pool for IPv4 addresses in system context and configuring the IP pool for IPv6 addresses in system context. **Step 1** Create the IP pool for IPv4 addresses in system context by applying the example configuration in the *IPv4 Pool Creation* section. **Step 2** Optional. Configure the IP pool for IPv6 addresses in system context by applying the example configuration in the *IPv6 Pool Creation* section. **Step 3** Verify your IP pool configuration by following the steps in the *IP Pool Configuration Verification* section. **Step 4** Save your configuration as described in the *Verifying and Saving Your Configuration* chapter. *See* WSOU-CISCO012990 [*GGSN Administration Guide, StarOS Release 21.3*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-3_N5-5/GGSN/21-3-GGSN-Admin.pdf, at 105 (April 27, 2017)]. To configure the IP pool:

<table>
<tr><td></td><td> 

Id. at 106.</td></tr>
<tr><td colspan="2">CLAIM 26</td></tr>
<tr><td>26[Pre.] A system comprising:</td><td>To any extent the preamble is limiting, Cisco’s Mobile Multimedia Gateway Platform includes a system comprising the following elements, as shown below.</td></tr>
<tr><td>26[A] a Serving General Packet Radio System (GPRS) Support Node (SGSN) configured to send a Create Packet Data Protocol (PDP) Context Request to a Gateway General Packet Radio System (GPRS) Support Node (GGSN) of a network, the Create PDP Context Request message having an APN</td><td>Cisco’s Mobile Multimedia Gateway Platform includes a system comprising a Serving General Packet Radio System (GPRS) Support Node (SGSN) configured to send a Create Packet Data Protocol (PDP) Context Request to a Gateway General Packet Radio System (GPRS) Support Node (GGSN) of a network, the Create PDP Context Request message having an APN (Access Point Name) field containing one or more parameters that explicitly indicates requesting either a private network address or a public network address to be assigned to a mobile station of the network.

For example, as shown in Step 3 below, to resolve the received APN in the PDP activation request message, the SGSN sends a Create PDP Context Request to the GGSN, which works in conjunction with the SGSN to identify the APN the mobile station is attempting to connect to and other information about the subscriber. The SGSN sends an APN Restriction value (Maximum APN Restriction) in the Create PDP Context Request for establishing a PDP context.

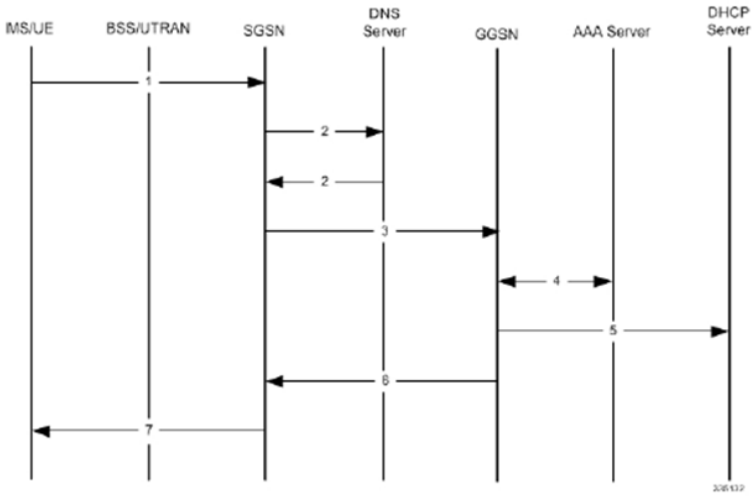
<table>
<tr><td>3</td><td>The SGSN sends a Create PDP Context Request message to the GGSN containing the information needed to authenticate the subscriber and establish a PDP context.</td></tr>
</table></td></tr>
</table>

(Access Point Name) field containing one or more parameters that explicitly indicates requesting either a private network address or a public network address to be assigned to a mobile station of the network;	*See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]. **SGSN and Dual Access SGSN Deployments** SGSNs and GGSNs work in conjunction within the GPRS/UMTS network. As indicated earlier in the section on *System Configuration Options*, the flexible architecture of StarOS enables a single chassis to reduce hardware requirements by supporting integrated co-location of a variety of the SGSN services. *Id*. at 5.

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

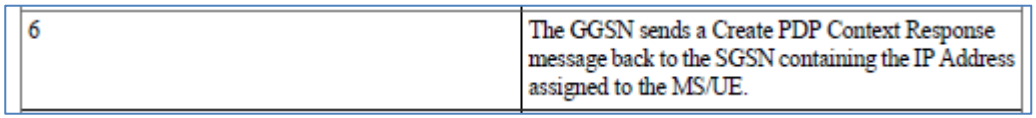
Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.

The APN indicates requesting either a private network address of a public network address. The GGSN/P-GW has an APN restriction value for each APN. The APN Restriction values explicitly indicate the request for a private or public network address to be assigned to the mobile station. For example, when the "APN Restriction Value allowed to be established" is "1" then the "Private" APN for Corporate is assigned in the exemplary manner shown below.

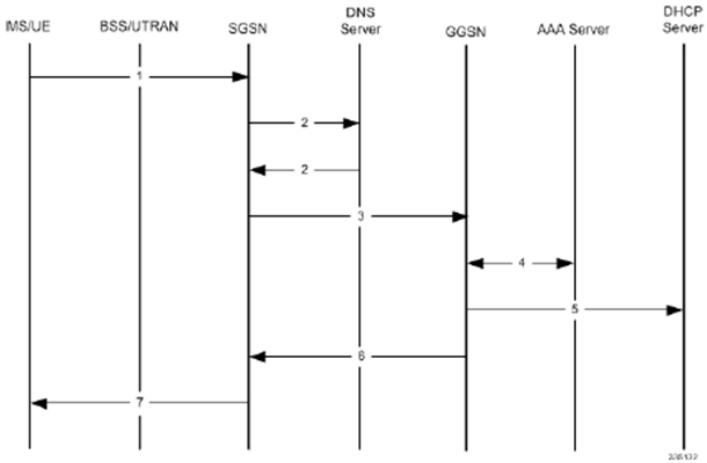
	Table 13: APN restriction values **Maximum APN Restriction Value** / **Type of APN** / **Application Example** / **APN Restriction Value allowed to be established** 0 / No Existing Contexts or Restriction / / All 1 / Public-1 / WAP or MMS / 1, 2, 3 2 / Public-2 / Internet or PSPDN / 1, 2 3 / Private-1 / Corporate (for example MMS subscribers) / 1 4 / Private-2 / Corporate (for example non-MMS subscribers) / None *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf at 184]. "During default bearer activation, the SGSN sends the current Maximum APN restriction value for the UE to the GGSN/P-GW in the Create PDP Context Request/Create Session Request (CSR). The GGSN/P-GW will have an APN restriction value for each APN. The UE's APN Restriction value determines the type of application data the subscriber is allowed to send." This indicates that each APN corresponds to either a public, or a private address, according to its associated APN restriction value. For example, the "APN Restriction value corresponding to each APN is known by the GGSN/P-GW. The Gn/S4-SGSN sends the Maximum APN Restriction of the UE ["User Equipment"] to the GGSN/P-GW in a Create PDP Context Request/Create Session Request. The GGSN/P-GW accepts or rejects the activation based on the Maximum APN Restriction of UE and APN Restriction value of that APN which is sent the Create PDP Context Request/Create Session Request... This feature provides the operator with increased control to restrict certain APNs to UEs based on the type of APN." *Id.* at 183-184; *see also, e.g.*, CISCO-WSOU-00007509 at 47, 202-203; CISCO-WSOU-00007552 at 45, 200-201; CISCO-WSOU-00007592 at 43; CISCO-WSOU-00005371; CISCO-WSOU-00005374; CISCO-WSOU-00005375; CISCO-WSOU-00005379.
26[B] a GGSN configured to send the Create PDP Context Request	Cisco's Mobile Multimedia Gateway Platform includes, on information and belief, a system comprising a GGSN configured to send the Create PDP Context Request message to a Border Gateway (BG).

message to a Border Gateway (BG); and	For example, Cisco's Mobile Multimedia Gateway Platform includes both "Standalone gateway GPRS support node (GGSN)" and "Co-located P-GW/GGSN" deployments and interfaces. On information and belief, the GGSN is configured to send the Create PDP Context Request message to a Border Gateway (Packet Gateway: P-GW). *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 6-7 (Aug. 29, 2019)].
26[C] a BG configured to send a Create PDP Context Response message to the GGSN,	Cisco's Mobile Multimedia Gateway Platform includes, on information and belief, a system comprising a BG configured to send a Create PDP Context Response message to the GGSN. For example, Cisco's Mobile Multimedia Gateway Platform includes both "Standalone gateway GPRS support node (GGSN)" and "Co-located P-GW/GGSN" deployments and interfaces. On information and belief, the Border Gateway (Packet Gateway: P-GW) is configured to send the Create PDP Context Response message to the GGSN. *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 6-7 (Aug. 29, 2019)].
26[D] the SGSN configured to receive the Create PDP Context Response from the GGSN.	Cisco's Mobile Multimedia Gateway Platform includes a system wherein the SGSN is configured to receive the Create PDP Context Response from the GGSN. For example, as shown below in Step 6, once an IP address (public or private depending on the APN request) is chosen, the GGSN sends a Create PDP Context Response message to the SGSN containing the IP address assigned to the mobile station.  6 — The GGSN sends a Create PDP Context Response message back to the SGSN containing the IP Address assigned to the MS/UE. *See* WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15*, CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 81 (Aug. 29, 2019)].

PDP Context Activation Procedures

The following figure provides a high-level view of the PDP Context Activation procedure performed by the SGSN to establish PDP contexts for the MS with a BSS-Gb interface connection or a UE with a UTRAN-Iu interface connection.

Figure 9: Call Flow for PDP Context Activation



The following table provides detailed explanations for each step indicated in the figure above.

Table 3: PDP Context Activation Procedure

Step	Description
1	The MS/UE sends a PDP Activation Request message to the SGSN containing an Access Point Name (APN).

See, e.g., WSOU-CISCO013800 [*SGSN Administration Guide, StarOS Release 21.15,* CISCO, https://www.cisco.com/c/en/us/td/docs/wireless/asr_5000/21-15_6-9/SGW-Admin/21-15-SGSN-Admin.pdf, at 80 (Aug. 29, 2019)]; CISCO-WSOU-00007509 at 99-100; CISCO-WSOU-00007552 at 98-99; CISCO-WSOU-00007592 at 94-95; CISCO-WSOU-00007605 at 89.